

A revision of the 'acaecate' earthworms of the *Pheretima* group (Megascolecidae: Oligochaeta): *Archipheretima*, *Metapheretima*, *Planapheretima*, *Pleionogaster* and *Polypheretima*

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Synopsis

Following the studies on the *Pheretima* group of Asia-Australasian earthworms by Sims & Easton (1972), those genera lacking intestinal caeca, *Archipheretima*, *Metapheretima* (inc. *Ephemitra*), *Planapheretima*, *Pleionogaster* and *Polypheretima*, are examined by taximetric procedures. One hundred and fourteen nominal species and subspecies are reviewed; 75 species are regarded as valid and a further 25 are described as new. Keys, descriptions and distributions are provided to the genera and species. The morphological development and structural specializations of the male pores are detailed and their taxonomic importance is discussed. The nephridial systems of several species are described and doubt is expressed about the validity of attributing classificatory significance to these characters. The distribution of the *Pheretima* group of genera is established in the context of plate tectonics and the restrictions are correlated with present day climatic factors.

Introduction

Sims & Easton (1972) employed numerical techniques to detect phenetic assemblages within the genus *Pheretima* auct. which at that time included 746 nominal species. From their studies on a sample of 114 species, they concluded that eight genera should be recognized. Four, *Archipheretima* Michaelsen, 1928, *Ephemitra* Sims & Easton, 1972, *Metapheretima* Michaelsen, 1928 and *Planapheretima* Michaelsen, 1934, contained species lacking intestinal caeca and the remaining four, *Amynthas* Kinberg, 1867, *Metaphire* Sims & Easton, 1972, *Pheretima* Kinberg, 1867 (*sensu* Sims & Easton, 1972) and *Pithemera* Sims & Easton, 1972, accommodated species with caeca on the intestine. The authors assigned the nominal species previously included in *Pheretima*

auct. to species-groups within these genera although they did not attempt to describe or taxonomically revise the individual species.

This report is a continuation of those taximetric studies and contains the results of critical appraisals of all the taxa included in the 'acaecate' genera (*Archipheretima*, *Ephemitra*, *Metapheretima* and *Planapheretima*) also the closely allied monotypic genus *Pleionogaster* Michaelsen, 1892. After full investigation, the genus *Metapheretima* is now redefined to include *Ephemitra* and some of its species are assigned to *Polypheretima* Michaelsen, 1934, previously a synonym. Numerical procedures similar to those employed by Sims & Easton (1972) were adopted to test the phenetic validities of the genera and to detect infra-generic groups. Descriptions, synonymies and distributions are given of 100 valid species which are recognized among the five genera investigated. The higher systematics and zoogeography of the acaecate genera are briefly discussed.

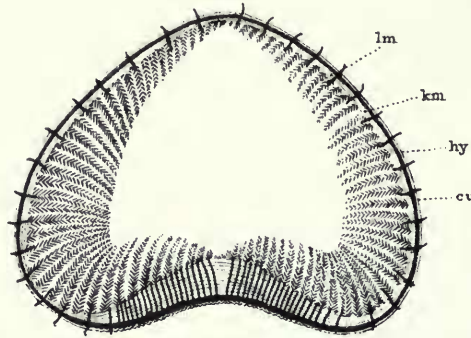


Fig. 1 *Planapheretima hasselti*, transverse section of body. *lm*, longitudinal muscle; *km*, circular muscle; *hy*, epidermis; *cu*, cuticle. (From Horst, 1883.)

Morphology

An account of the morphological features observed to vary among the species of the *Pheretima* group of genera and found to be useful for delineating taxa was provided by Sims & Easton (1972). Since then the taxonomic significance of variations in setal number, segment size and number of spermathecae has been demonstrated by Easton (1976). During the course of the present investigation it became apparent that further morphological specializations can usefully be employed for generic and specific recognition. The following require comment.

1 Body shape

The body shape of most species is approximately circular in cross-section although it may be flattened or concave ventrally in the region of the genital field. The spasmodic contraction of the *archiform muscles* (Oishi, 1930) in the more anterior segments during preservation may in particular give the body a flattened appearance. The majority of species included in *Planapheretima* are arboricolous, these too have depressed bodies but with the longitudinal muscles grouped in paired lateral blocks (Fig. 1). (Associated with this condition are cryptic coloration, crowded ventral setae and often a glandular ventral surface forming a 'creeping sole'.)

It is assumed that the diameter : length proportion is constant for individuals of all species of the *Pheretima* group killed by a standard method (excluding regenerating specimens) as established for *Amyntas hupiensis* by Grant (1955).

2 Setae

Examination of long series of individuals show that, in the *Polypheretima elongata* species-complex, the number of setae on segment *vii* is positively correlated with the volume of that segment and that two groups of taxa may be recognized with different setal densities (Easton, 1976). In *Metapheretima sentanensis* and *M. triciae* the setal densities are considerably higher and they

form a third group (Fig. 2). Unfortunately the majority of other species discussed in this report are known only from one or few individuals. Nevertheless, it is possible to assign these taxa to one or other of the three groups recognized on the basis of data derived from the examination of a single individual. The number of setae increase posteriorly usually to about segment xxx and then decrease in number to the posterior end of the body (Beddard, 1895 : 291; Hatai, 1924; Sivickis, 1930). These variations are not included among the taxonomic criteria employed in the present revision.

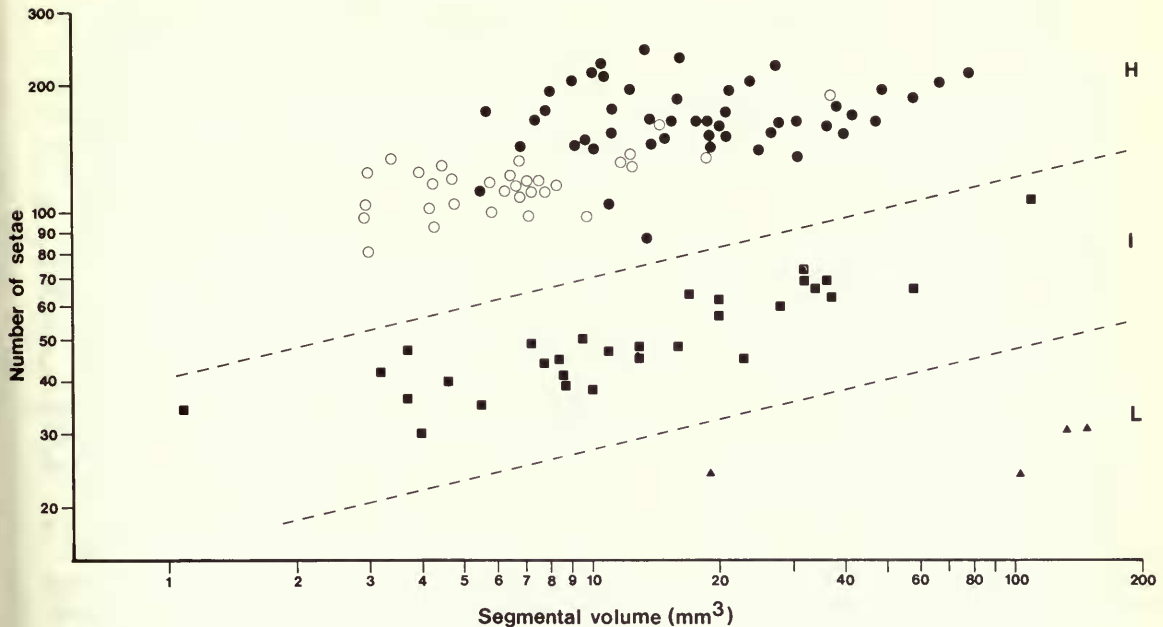


Fig. 2 Correlation between the number of setae and segmental volume of segment vii (scales logarithmic). Setal densities: L, low (*Polypheretima kinabaluensis*); I, intermediate (*P. elongata*, *everetti*, *phacellotheca* and *stelleri*); H, high (closed circles – *Metapheretima sentanensis*, open circles – *M. triciae*).

The setae are usually situated in a single ring around the equator of each segment, but in a few species of *Planapheretima* and *Metapheretima* some may be displaced to form two or three rings. In most species the setae are regularly distributed around each segment, being rarely crowded ventrally or dorsally. However, in the majority of species of the genus *Planapheretima* the setae are densely crowded ventrally (see *Body shape*).

The ventral and dorsal gaps in the setal ring (*aa* and *zz*) are often larger than the adjacent gaps (*ab* and *yz*) but seldom exceed twice the size of the adjacent gaps; exceptionally in *Archipheretima* they are much larger and in *A. ophioides* the dorsal gaps are equal to one quarter of the body circumference. The conventional setal nomenclature has been followed throughout (Stephenson, 1930).

Penial setae occur rarely in the *Pheretima* group of genera and are unknown among the acaecate species.

3 Dorsal pores

The location of the first dorsal pore is fairly constant in most species, usually occurring in the region of 11/12 but it may be in any furrow between 5/6 and 13/14, even 19/20 in the case of *Polypheretima coplandi*.

4 Clitellum

The clitellum is usually restricted to three segments (*xiv-xvi*) but it may begin on *xii* or *xiii* and extend posteriorly to *xvii* or *xviii*. The clitellum is annular on segments *xiv-xvii* but may be incomplete ventrally on *xii*, *xiii* or *xviii*. All of the species of *Polypheretima* as well as the majority of *Metapheretima* have clitella restricted to three segments. All of the species of *Archipheretima* and *Pleionogaster* have extended clitella as do most of the species of *Planapheretima*. Occasionally clitella are found to be poorly developed in fully grown individuals. This condition is believed to be characteristic of a postsexual phase (Gates, 1972a : 318).

5 Male pores

The species investigated may be divided into two groups on the basis of the structure of the male pores. In the first, each male pore is situated in the centre of a circular or oval papilla, the porophore, which is often pigmented; crescentic genital markings are never associated with these pores (while the spermathecal pores are always small). In the second group the male pores do not discharge through porophores and crescentic markings are often present (here the spermathecal pores may be small or large).

In both groups the male pores may have accessory structures which show a wide range of intra- and inter-specific variation. Among these diversifications it is possible to recognize a morphological series of increasing complexity in each group ranging from a simple superficial pore to a condition in which the pore discharges into a copulatory pouch. In a separate study of the ontogenesis of species possessing the more complex pore structures, it was found that during development each individual passes through successive growth phases which represent the condition of adults of less highly specialized species. The structure and development of the copulatory pouches in the two groups differ yet the developmental processes are sufficiently similar for the two to be regarded as an example of parallel development.

(a) *Male pores on porophores.* The total range of variation in the structure can be traced during growth in *Polypheretima elongata* and, in the case of the more complex structure, *P. koyana*.

In the immature condition (Fig. 3a-b) the circular porophore of *elongata* is faintly demarcated with a poorly discernible crescentic ridge enclosing the porophore. With increased maturity both the porophore and the ridge become more distinct (Fig. 3c). During the next phase the porophore begins to invaginate along its lateral margin while its median edge often becomes raised above the surface of the body (Fig. 3d). At its maximum development in *elongata*, the porophore is almost completely enclosed leaving only a characteristic crescentic aperture to the copulatory pouch visible on the body surface (Fig. 3e). In this species the copulatory pouch is restricted to the body wall and does not invade the coelom; the porophore occupies the medial wall of the copulatory pouch.

Juvenile individuals of *Polypheretima koyana* have copulatory pouches indistinguishable from those described above in mature adults of *elongata* (Fig. 3e). With increasing maturity the aperture to the pouch of *koyana* becomes a longitudinal slit and develops tumid lips while the porophore occupies the floor of the pouch (Fig. 3f). Insufficient material of this species is available to allow intermediate stages between figures 3e and 3f to be recognized.

Male pores are on porophores in all species of *Polypheretima* as well as some species of *Archipheretima* and *Planapheretima*. The porophores may be within copulatory pouches in species of *Polypheretima*. However, it is possible that when more mature individuals become available for study some of the species which are noted as having simple male pores will be found to have more complex structures.

Chen (1946) described the porophores of *Planapheretima continens* as occasionally bearing a penis-like structure (Fig. 3g), this species has not been examined. However, during the examination of an individual of *elongata*, a similar structure was observed which proved to be an artifact caused by an incomplete removal of the cuticle.

(b) *Male pores lacking porophores.* The stages in development of the male pore present in the species lacking porophores are represented in a series of individuals of *Metapheretima kili* and, in the case of the most complex condition, *M. oinakensis*.

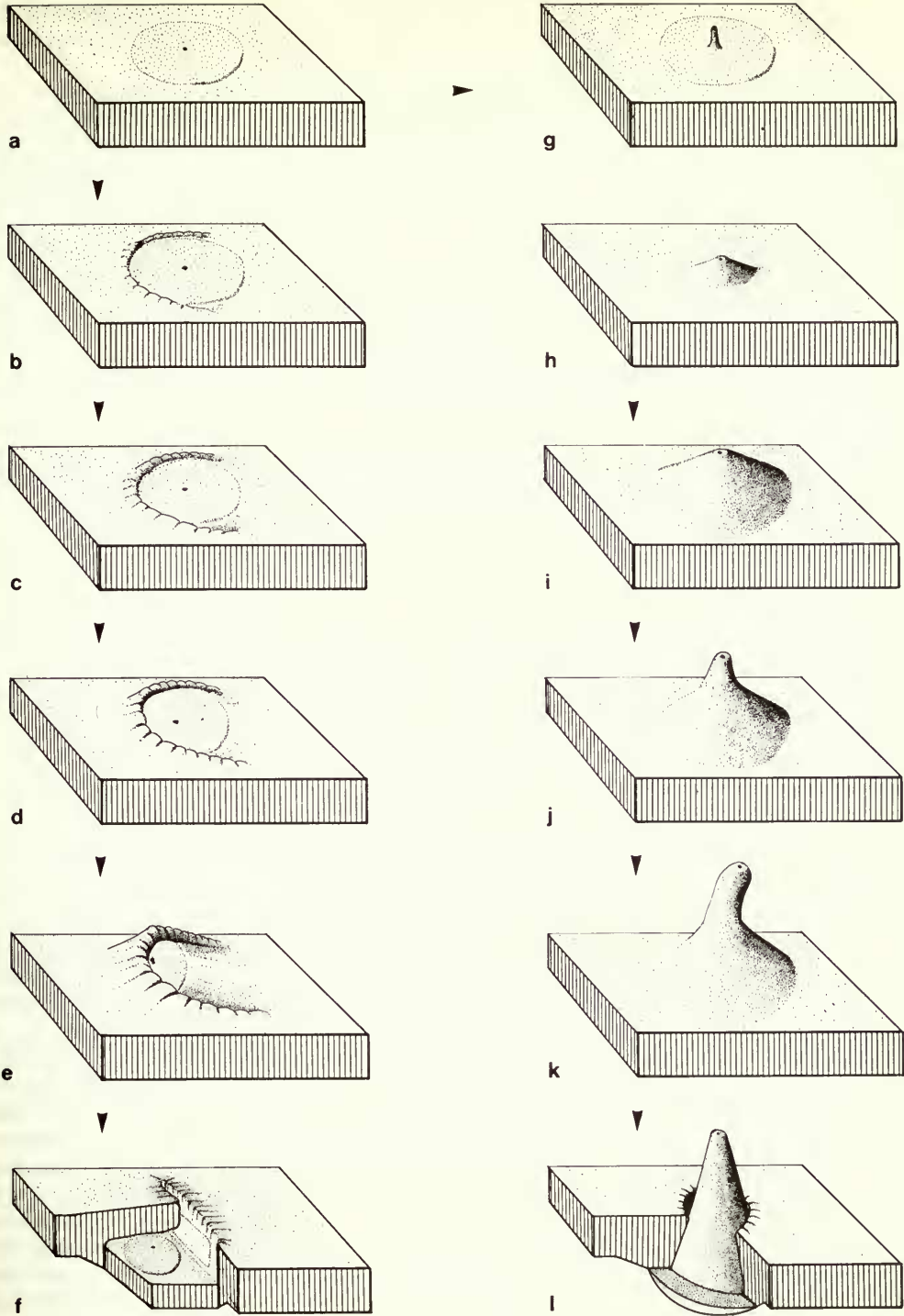


Fig. 3 Development of male pores. (a-f) *Polypheretima*; (g) *Planapheretima continens*; (h-l) *Metapheretima*.

In an immature individual of *kilii* the male pore is at the centre of a low conical body (Fig. 3h). With increasing maturity the conical body increases in size and elevation (Fig. 3i), and the upper portion finally develops into a slim, penis-like structure (Figs 3j-k).

In *oinakensis* the male pore is terminal on a slim penis similar to that found in *kilii* (Fig. 3k), but it is incorporated within a copulatory pouch (Fig. 3l). The intermediate stages by which this form of copulatory pouch develops are unknown, but in view of its different structure they are unlikely to be similar to those found in *elongata*. Development possibly involves the invagination of the body wall around the whole periphery of the basal end of the penis.

Male pores lack porophores in all species of *Metapheretima* and *Pleionogaster* and some species of *Archipheretima* and *Planapheretima*. The male pores may be in copulatory pouches in species of *Metapheretima*. Several species (*Metapheretima deirdrae*, *jocchana* and *sembaluensis*, *Pleionogaster horsti*, *Planapheretima maculata*) have male pores considerably larger than those usually encountered.

In two species, *Archipheretima ophioides* and *Planapheretima hasselti*, the male pores are on raised areas which extend onto xviii-xx and xvii-xix respectively (Figs 12a and 29b).

6 Female pores

The female pores are either paired or single, occurring ventrally on the equator of segment *xiv*. Occasionally individual variants may have paired female pores, although they belong to species in which the pore is usually single, the converse condition also occurs.

7 Genital markings

Glandular areas and other markings are present on the ventral surface of the anterior body wall of both clitellate and acitellate individuals of many species. The nature and arrangement of these markings are specifically distinct and so provide valuable diagnostic information. They vary intraspecifically but these differences (degree of development and number of markings) may be attributed principally to growth since the patterns are usually constant in mature worms.

(a) *Diffuse genital markings* with poorly defined periphery are present only in the *Archipheretima iris* species-group where they are always intersegmental (Fig. 4a).

(b) *Discrete genital markings* with clearly defined periphera commonly occur in all of the genera revised below, they are usually segmental and only rarely intersegmental. These markings are usually circular or oval and differentiated into two or more concentric areas (large markings, Fig. 4b, small Fig. 4d); rarely, in *Polypheretima aringeana*, the central area of each genital marking is differentiated into small spots (Fig. 4e). The glandular tissue associated with the markings is usually restricted to the body wall, termed 'sessile' (Gates, 1972a). In species with very small markings, such as *grata*, the glandular tissue may invade the coelom in the form of a stalked gland. (In *grata* genital markings are present within the copulatory pouches but absent from the external, postclitellar ventral body surface.)

The genital markings on segment *xviii* are often similar in shape and position to those on adjacent segments, but they may be crescentic in shape and are closely associated with the male pores (Fig. 4c). Crescentic markings are present in *Metapheretima* (distinguishing the genus from *Polypheretima*), *Pleionogaster* and possibly two species of *Planapheretima* (*celebensis* and *moultoni*). Histologically crescentic markings are indistinguishable from the more common circular and oval genital markings.

(c) *Annular ridges* encircle the male pores in several species of *Metapheretima* (*orcrista*, *parmata*, *glamdringi*, *jocchana*) and one species of *Planapheretima* (*maculata*). Several other species of *Metapheretima*, all members of the *oinakensis* species-group, have similar, but less extensively developed structures. Functionally these structures would appear to facilitate the transfer of sperm between opposing male and spermathecal segments during copulation.

8 Septa

In the oesophageal and pharyngeal regions septa are often absent, incomplete or thickened. Considerable variation exists within a species and septal characters appear to be of little diagnostic

value (especially in view of the imprecise terms 'delicate', 'membranous', 'thickened', etc., which are used in descriptions). The absence or incomplete development of the septa associated with the gizzard (8/9 and 9/10) and, when present, the oesophageal pouches (10/11 and 11/12) can be correlated with the degree of development of these organs. In *Pleionogaster*, in which the oesophageal gizzard is vestigial, the anterior septa are uniform.

The septal muscles form part of the musculature of the hydrostatic skeleton (Chapman, 1958). Thickened muscular septa may therefore be indicative of an active burrowing species, certainly the musculature is poorly developed in arboricolous forms whose functional requirements are different.

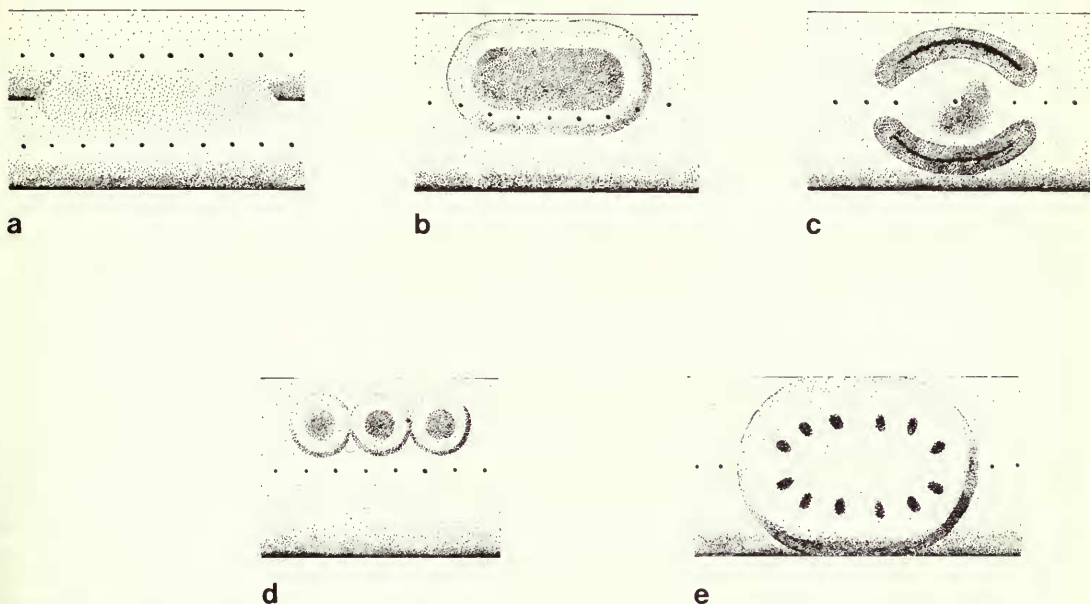


Fig. 4 Terminology of genital markings. (a) diffuse; (b) large discrete; (c) crescentic; (d) small discrete; (e) *Polypheretima aringearia* type.

9 Alimentary canal

Within the Megascolecidae (*sensu* Gates, 1959) the *Pheretima* group of genera is characterized by the presence of an oesophageal gizzard in *viii*. In most species the gizzard is well developed, invading the next two posteriad segments, but in the monotypic *Pleionogaster* it is vestigial and its function is taken over to some extent by the intestinal gizzards which characterize the genus. Oesophageal pouches, structures of unknown function, may be present in some species of *Metapheretima*. They are usually paired, flexed anteriorly, and arise from the dorsal surface of the oesophagus immediately posteriad to the gizzard. The extent of their development varies considerably among the series examined; they are often darkly pigmented and always have a well-developed blood supply.

Intestinal caeca are absent from most of the species investigated with the exception of a few Asian species of *Planapheretima*. In some of the latter and several related acaecate forms, the intestinal wall was reported as being glandular (Chen, 1946) but it has not been possible to examine material and the taxonomic significance of this specialization is uncertain.

10 Lateral hearts

Four pairs of circumoesophageal contractile blood vessels are usually present, one pair in each of *x-xiii*, although the posterior or anterior pair may be absent or incomplete. As the number of

pairs often vary individually within a species, the differing conditions are of little taxonomic significance.

11 Anterior male reproductive system

The majority of species of the *Pheretima* group are holandric (testes paired in both x and xi) as are all of the known species of *Archipheretima*, *Planapheretima* and *Pleionogaster*. Species with a proandric condition (testes paired in x only) are rare and acaecate examples are accommodated in *Metapheretima* (with the possible exception of *sibogae* in *Polypheretima*). Metandric species (testes paired in xi only) occur in both *Polypheretima* and *Metapheretima*; in the former genus metandry is restricted to (and diagnostic of) members of the *badia* and *patae* species-groups. However, in *Metapheretima* the character has a limited taxonomic value since metandry is present in most of the species-groups recognized.

With the possible exception of several species of *Archipheretima*, the testes are invested by tough membranous sacs in all species of the *Pheretima* group, including *Polypheretima fida*, although testes sacs were recorded as being absent in this species (Michaelsen, 1913b; Stephenson, 1930). In *Archipheretima* the sacs are usually more delicate and larger, mostly forming a lining to the parietal wall, although they have been reported as absent in some species (Gates, 1970a). The shape and the extent of the testes sacs varies with genus, species and to some extent with the maturity of an individual. In a few species the seminal vesicles and lateral hearts may also be enclosed within the testes sacs.

The seminal vesicles are paired, posteriorly directed, sac-like evaginations of the hinder septa of each testes segment. In most species each pair is restricted to one segment where their size varies with maturity, but in several Chinese species of *Planapheretima*, they extend several segments anteriorly and posteriorly.

Small, paired sacs which resemble the seminal vesicles may be present on the posterior surfaces of septa 12/13 and 13/14. These structures of unknown function have been termed *ovisacs* (Beddard, 1895), *coelomic sacs* (Sims & Easton, 1972) and *pseudoseminal vesicles* (Gates, 1972a). It is proposed here to adopt the term *pseudoseminal vesicles*, to avoid confusion with other structures described as *coelomic pouches* and *coelomic sacs* by Beddard & Fedarb (1902).

12 Ovaries

The female gonads are paired and free in $xiii$ in all the species investigated as well as the majority of other species of the *Pheretima* group. However, the ovaries are enclosed in delicate walled sacs in *Pithemera mira* and several related taxa from New Britain and nearby islands (Gates, 1972b).

13 Spermathecae

The duct and ampulla of each spermatheca are distinctly demarcated in mature individuals of most of the species reviewed here. In immature specimens, and mature examples of *Archipheretima*, the duct merges gradually into the ampulla. In species of the acaecate genera a diverticulum (rarely several diverticula) arises from the spermathecal duct and provides a useful diagnostic character for generic, species-group and specific identifications. Several types of diverticula are encountered (Fig. 5).

The spermathecal pores may be either small (and difficult to see) or large, often within tumid lips. Gates (1972a : 150) described the large spermathecal pore as secondary since he recognized a minute (primary) pore within the invagination. The taxonomic aspect of this specialization was not investigated during the present study.

The number and situation of spermathecae may vary within a thecal segment. These variations are reflected in the arrangement and number of spermathecal pores which are often diagnostic of species-groups and species. The pores may be segmental as in *Polypheretima annulata* and *P. voeltzkowi* or, more usually, intersegmental. In both situations they occur either in a single furrow, or segment, or in several consecutive furrows between 4/5 and 8/9, even 7/8/9/10 in the case of *Metaphire sanseiana* (Ohfuchi, 1951). When monothecate there is a single pore either dorsally or

ventrally placed in each segment (a single lateral pore indicates an abnormal example of a bithecate species). Bithecate species have two symmetrically placed pores, while numerous pores arranged in paired symmetrically placed batteries are external evidence of polythecate species. Most species are monothecate, bithecate or polythecate but some may be divided, being, for example, bithecal in some segments and polythecal in others. Immature specimens of polythecal species may be bithecal while the number of spermathecae in the batteries of the species of the *Polypheretima elongata* species-complex increases with maturity (Easton, 1976).

In bithecal and polythecal species the ventral separation of the pores (or batteries) can be expressed as a fraction of the body circumference at that segment. This proportion is reasonably constant in a taxon and often diagnostic. In this paper the separation of the most posterior spermathecal pores is utilized since occasionally the more anterior pores are more closely paired.

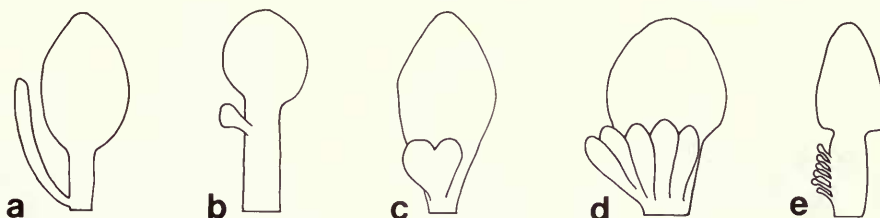


Fig. 5 Spermathecae. (a) differentiated with simple ectal diverticulum; (b) differentiated with simple ental diverticulum; (c) undifferentiated with multilocular diverticulum (*Archipheretima*); (d) differentiated with multilocular diverticulum (*Metapheretima*); (e) differentiated with numerous diverticula.

14 Nephridia

The nephridia were excluded from the present numerical and taxonomic investigations due to the uncertainty about their systematic significance (see Classification) and for much the same reasons that they were omitted by Sims & Easton (1972). The study of the nephridia would necessitate the destructive dissection of well-preserved specimens, and it was clearly undesirable to go to such extreme lengths to obtain information. Secondly, some species are represented by specimens often in poor condition due to either inadequate fixation, or previous dissections, so that information can no longer be obtained from them. Only a minority of the original descriptions include details of the nephridial system, so that it would be difficult to correlate this information.

Nevertheless, variations in the nephridial system of a few species were studied for other reasons since, in the most recent classification of the Megascolecoïd earthworms, Jamieson (1971a & b) attributed considerable systematic importance to the structures of the excretory systems (see Classification).

Numerical studies

Introduction

Since only 14 acaecate species were assessed in the numerical investigations of Sims & Easton (1972), it was decided to subject the majority of the 92 species recognized here to a fuller numerical appraisal. The taxa selected for study and the characters assessed are listed in Tables 1 and 2 respectively. The data utilized was extracted from the specific descriptions in the taxonomic section of this paper, instead of from the examination of a single individual which has been the practice of earlier authors. The techniques used resemble those employed by Sims & Easton (1972) but the analyses were performed with the aid of a program adapted from the CLASP computer program (Gower & Ross, Rothamsted Experimental Station) for use with the Varian V72 computer in the British Museum (Natural History). The mutual similarity coefficients

of the taxa investigated were calculated using a coefficient of similarity defined for both quantitative and qualitative characters. A two-dimensional plot of the taxa involved was obtained using the method of principal co-ordinates analysis and a Minimum Spanning Tree (MST) was added to the plot.

Table 1 List of taxa studied in numerical investigations

<i>Archipheretima</i>	30 <i>glamdringi</i>	60 <i>lesonea</i>
1 <i>iris</i>	31 <i>kiliti</i> *	61 <i>pentacystis</i>
2 <i>margaritacea</i>	32 <i>oinakensis</i>	62 <i>polytheca</i> *
3 <i>mazarredi</i>	33 <i>orcrista</i>	63 <i>renschi</i>
4 <i>zonata</i>	34 <i>parmata</i> *	64 <i>badia</i>
5 <i>ophiodes</i>	35 <i>stingi</i>	65 <i>elberti</i>
6 <i>picta</i>	36 <i>jocchana</i>	66 <i>kellneri</i>
		67 <i>swelaensis</i>
<i>Metapheretima</i>	<i>Polypheretima</i>	68 <i>sibogae</i>
7 <i>arensi</i>	37 <i>annulata</i>	69 <i>coplandi</i> *
8 <i>bulmeri</i>	38 <i>fakfakensis</i>	70 <i>kershawae</i>
9 <i>carolinensis</i>	39 <i>bifaria</i>	71 <i>patae</i>
10 <i>elrondi</i>	40 <i>brevis</i>	
11 <i>pallens</i>	41 <i>fida</i>	<i>Planapheretima</i>
12 <i>pickfordi</i> *	42 <i>gatesi</i>	72 <i>continens</i>
13 <i>queribunda</i> *	43 <i>iizukai</i>	73 <i>lacerina</i>
14 <i>quiqueremis</i>	44 <i>mertoni</i>	74 <i>tenebrica</i>
15 <i>sembaluensis</i>	45 <i>monticola</i>	75 <i>bambophila</i>
16 <i>sentanensis</i>	46 <i>panarana</i>	76 <i>arboricola</i>
17 <i>simsi</i> *	47 <i>sempolensis</i>	77 <i>celebensis</i>
18 <i>sola</i>	48 <i>sepikensis</i>	78 <i>moultoni</i>
19 <i>speiseri</i>	49 <i>taprobanae</i>	79 <i>palescens</i>
20 <i>triciae</i>	50 <i>grata</i>	80 <i>rufomaculata</i>
21 <i>trukensis</i>	51 <i>voeltzkowi</i>	81 <i>subulata</i>
22 <i>loriae</i>	52 <i>annamensis</i>	82 <i>ambulatrix</i>
23 <i>neoguinensis</i>	53 <i>aringeana</i>	83 <i>hasselti</i>
24 <i>septocta</i>	54 <i>elongata</i>	84 <i>maculata</i>
25 <i>sucklingensis</i>	55 <i>everetti</i> *	85 <i>nieuwenhuisi</i>
26 <i>durendali</i>	56 <i>kinabaluensis</i> *	
27 <i>excalaberi</i>	57 <i>phacellotheca</i>	<i>Pleionogaster</i>
28 <i>andurili</i>	58 <i>stelleri</i>	86 <i>horsti</i>
29 <i>dorii</i>	59 <i>koyana</i>	

* Species not included in the initial numerical study.

Four separate numerical investigations were made. Firstly, a general study was undertaken to re-appraise the 'acaecate' genera recognized by Sims & Easton (1972). One result of this study was that *Ephemitra* is merged with *Metapheretima*, which is itself restricted, and the excluded species are here accommodated in *Polypheretima*. Then followed independent studies of each of the genera *Metapheretima*, *Planapheretima* and *Polypheretima* to detect the phenetic inter-relationships of their component species. Comparable information on the small genus *Archipheretima* is obtainable from the initial, general computations while *Pleionogaster* is monotypic. The results of these studies are discussed under each genus in the taxonomic section.

General Study

Seventy-eight species were utilized to provide data for the re-appraisal of the genera recognized by Sims & Easton (1972). It was not possible to include all of the species listed in Table 1 because of the limited capacity of the computer program employed, the taxa marked by an asterisk were those excluded from this study.

The configuration of the taxa with the first and second vectors of the principal co-ordinates analysis as axes is shown in Fig. 6. A considerable degree of clustering is evident, which becomes clearer with the addition of the Minimum Spanning Tree (MST) with graded linkages. Four major clusters may be recognized. Two, indicated by square and triangular symbols, comprise the six species of *Archipheretima* and 14 species of *Planapheretima* respectively, which by their discreteness and the low values of the MST linkages with other clusters confirm the validities of the genera. The two other clusters, indicated by closed and open circular symbols contain the taxa

Table 2 Characters used for computing coefficients of similarity

1	Mean longitude
2	Mean latitude
3	Ratio of lengths of arcs containing first five dorsal setae (<i>v-z</i>): first five ventral setae (<i>a-e</i>) on segment <i>vii</i>
4	Shape of body in cross-section: circular or depressed
5	Creeping sole: present or absent
6	Segment number of anterior end of clitellum
7	Segment number of posterior end of clitellum
8	Size of spermathecal pores: large or small
9	Ratio of distance apart of posteriormost spermathecal pores: circumference of body
10	Position (furrow number) of anteriormost spermathecal pores (one 'furrow' = setal row - setal row)
11	Position (furrow number) of posteriormost spermathecal pores
12	Position of spermathecal pores: postsetal, intersegmental, or presetal
13	Main number of spermathecal pores per furrow
14	Origin of spermathecal diverticula: ectal or ental
15	Condition of spermathecal diverticula: single or multiple
16	Condition of male pores: crescentic copulatory pouches, slightly invaginated porophore, superficial porophore, superficial lacking porophore, penate simple or penate within copulatory pouches
17	Size of male pore (superficial lacking porophore only): large or small
18	Ratio of distance apart of male pores: circumference of body
19	Annular ridges associated with male pores: absent or present
20	Crescentic markings associated with male pores: absent or present
21	Form of genital markings: diffuse or discrete
22	Postclitellar genital markings (discrete only) number on each segment
23	Glands associated with genital markings: sessile or stalked (discrete only)
24	Oesophagus: simple, slightly pouched, or distinctly pouched
25	Intestine: caecate, simple, with gizzards
26	Intestinal wall: unspecialized or glandular
27	Number of first intestinal segment
28	Condition of testes: proandric, holandric or metandric
29	Condition of testes sacs: absent, large membranous, annular, large paired, small paired

previously assigned to *Metapheretima* by Sims & Easton (1972). The species identified by closed circular symbols have male pores which lack porophores but usually have crescentic markings associated with them. The male pores sometimes discharge from within copulatory pouches when they are on elongate penes. The taxa principally from the Papuan region, have diverse types of spermathecal diverticula and genital markings which are usually in longitudinal rows. Included in this cluster are the type species of *Metapheretima* Michaelsen, 1928 and *Ephemitra* Sims & Easton, 1972. The taxa indicated by open circular symbols have the male pores on porophores which lack associated crescentic markings. These male pores sometimes discharge into copulatory pouches when the porophore forms a short truncate penis. The taxa, which come from all parts of the *Pheretima* group domain, always have simple spermathecal diverticula, but together exhibit a wide diversity of patterns of genital markings. The type species of *Polypheretima* is included in this cluster. The degree of separation of the clusters and the evidence of the MST linkages permit the recognition of two distinct genera *Metapheretima* and *Polypheretima*.

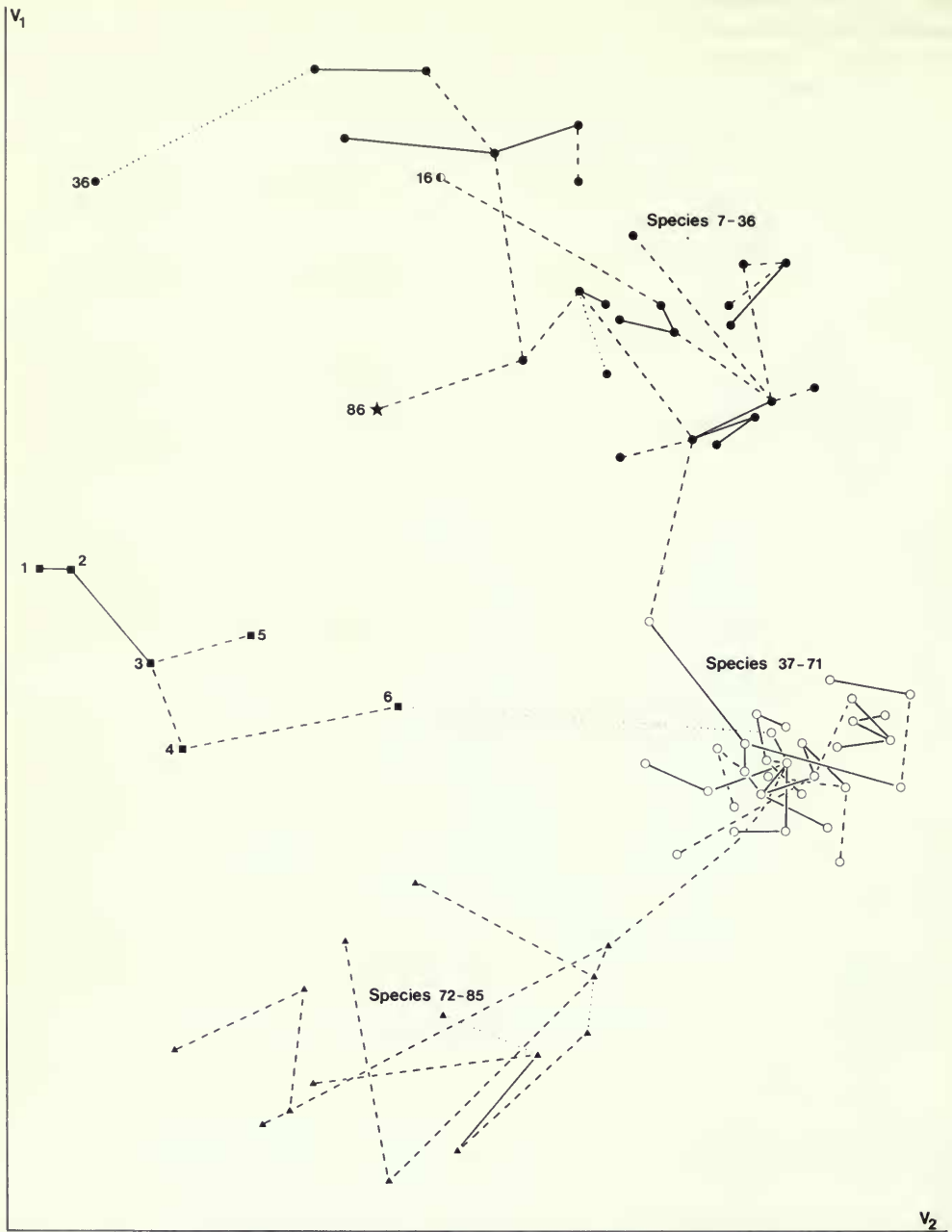


Fig. 6 Principal co-ordinates analysis of 78 'acaecate' species: the configuration of the species with the vectors corresponding to the first and a second latent roots. The linkages of the added Minimum Spanning Tree are graded to indicate percentage similarities; —, +95%; ----, 90-95%; ····, -90%. The genera recognized are depicted thus: *Pleionogaster* - star-shaped symbol; *Metapheretima* - closed circular symbols; *Polypheretima* - open circular symbols; *Archipheretima* - square symbols; *Planapheretima* - triangular symbols.

The species *horsti*, represented by a star in Fig. 6, is linked by the MST to *Metapheretima* (indicated by closed circular symbols) at 90.0% similarity. This value is higher than many of the MST linkages within *Metapheretima* and the locus of *horsti* is closer to the centre of the cluster than several taxa of *Metapheretima*, notably *jocchana* (36). Nevertheless, *horsti* is the type species and only representative of the genus *Pleionogaster* which is unique among the Megascolecidae in possessing intestinal gizzards. Since this character is not only unique but also considered by most workers to be of considerable systematic importance, it is proposed to retain this genus as a separate entity.

Except for these changes, the numerical results are in accord with those of Sims & Easton (1972), when a dissimilar set of morphological attributes were coded and processed on a larger computer. These authors indicated that the species accommodated here in *Polypheretima* could be distinguished from other acaecate forms, but they were uncertain of the taxonomic significance of the diagnostic characters of this group, and refrained from separating the species taxonomically.

Distribution

The distribution of the acaecate members of the *Pheretima*-group of genera need to be discussed in the context of the indigenous ranges of all the species within the group. Moreover, assessments of the affinities and origin(s) of the individual pheretimoids need to be considered in the light of the wider distribution of the group as a whole.

The *Pheretima* group domain

The concept of the *Pheretima* group domain, the area in which all of the autochthonous species of the *Pheretima*-group of genera occur (Fig. 7), was pioneered by Michaelsen (1903b, 1908, 1928b). In the last work the area was defined as comprising Japan, China, Burma through south-east Asia and the Indo-Australasian Archipelago to Queensland then to New Caledonia, the New Hebrides, the Caroline Islands and, tentatively, the Comoro Islands. The results of recent collecting now make it possible to establish most of the boundaries with greater precision. The northern limit is bounded by the most northerly records of *Metaphire aggera* (Kobayashi, 1934) which form a line linking Chihfeng, Yamhsin (Chinhsein) and Tashihkiano (Tashihchiano) in Manchuria with P'yongyang (Heijo) and Kumgang-san (Mt Kongo) in Korea (Kobayashi, 1940). In the west, Chen (1931, 1936, 1946) recorded a rich indigenous fauna from Szechwan Province while Gates (1972a : 149) recognized that the Chindwin-Irrawaddy axis marked the westerly limit of the domain in Burma. In the south only a single indigenous representative of the *Pheretima* group, *Amyntas queenslandicus* (Fletcher, 1887), has been recorded from Australia since *enchytraeoides* Michaelsen, 1916, also from Queensland, was shown by Gates (1961) to be a synonym of the peregrine species *A. minimus* (Horst, 1893). Expeditions organized by Dr B. G. M. Jamieson have collected several new indigenous species in northern Queensland, although only peregrine species were found in Northern Territory (Easton, in prep.). It seems certain, therefore, that much of the tropical forest of Queensland belongs to the domain. The precise eastern limit of the domain is uncertain, since several species have ranges which include Pacific islands. Species have been described from the Marianas, Caroline Islands, Solomon Islands, New Hebrides and Loyalty Islands, which have not been encountered in other parts of the domain and it seems reasonable to follow Michaelsen (1928b) and include at least these islands within the realm. The Comoro Islands also possess a species of the *Pheretima* group which does not occur elsewhere. Although Michaelsen (1928b) included the Comoro Islands within the domain, in view of the evidence discussed below, these islands are here excluded.

It is evident that the *Pheretima* group domain extends throughout the forested lands of Asia and Australasia, but it is curiously restricted in some areas. In the north and northwest the limiting factors are apparently climatic. In Korea and Manchuria the northern boundary coincides with the 8° isotherm (annual mean temperature), and in Manchuria the western limit of the domain is marked by the 400 mm isohyet (Kobayashi, 1940). It is possible that isolated populations may occur in moist refuges to the west of the 400 mm isohyet since it has been suggested (Wadia, 1960) that the dessication of central Asia is a post-glacial phenomenon. To the southwest the 400 mm

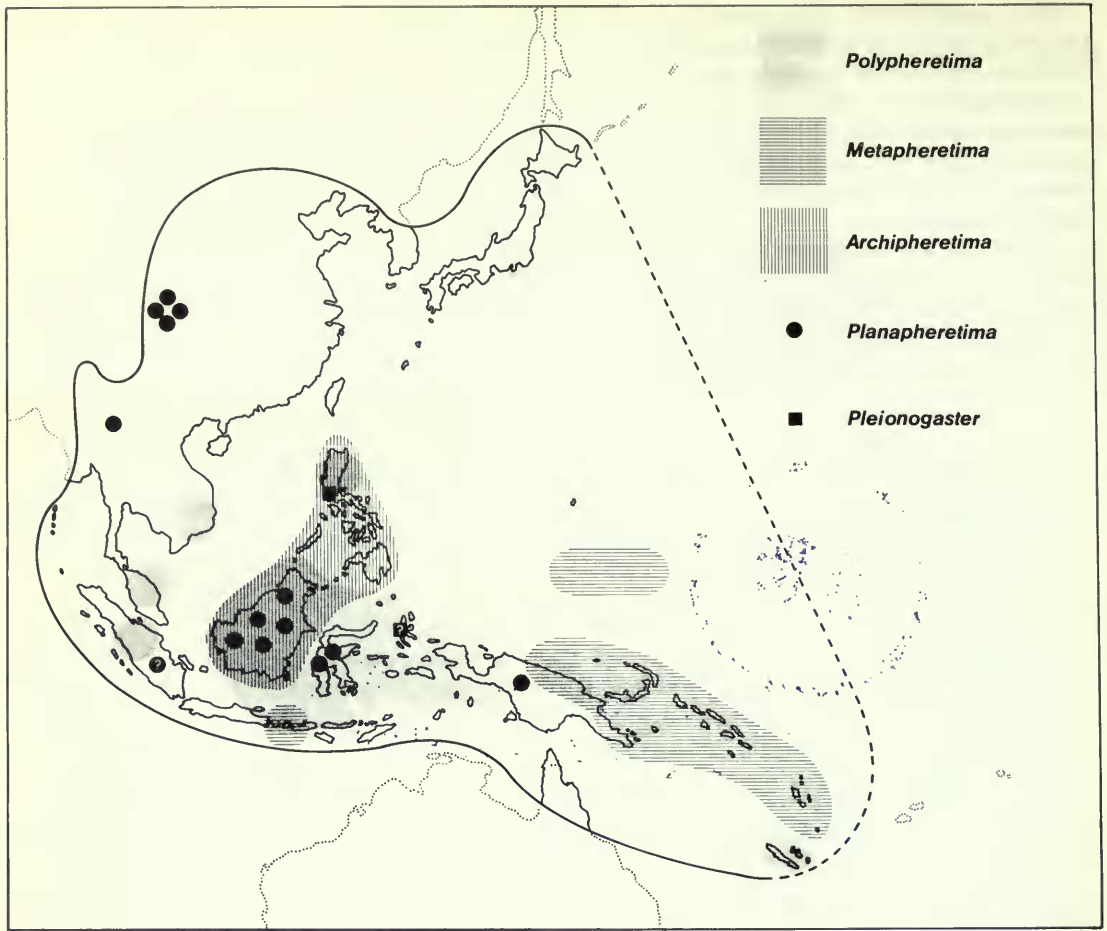


Fig. 7 Geographical limits of the *Pheretima* group domain and the distribution of the acaecate genera.

isohyet enters the Himalayas, where low precipitation and temperature provide a major barrier to earthworm migration.

Further south there are neither rainfall nor temperature barriers of any significance which may be correlated with limits of the *Pheretima* group. Nevertheless, a discrete boundary can be seen to exist and here it is necessary to examine the Caenozoic palaeogeography of Asia and Peninsula India to understand the pattern of distribution. During the Mesozoic when the Tethys ocean separated Peninsula India from Asia the direct interchange of earthworm faunae was not possible. In the Tertiary era conditions changed and the Indian and Asian plates approached their present relative positions. Western Burma and Bangladesh remained a barrier to earthworm migrations, since the Cretaceous and Tertiary sediments in this area did not become land to any great extent until the end of the Pliocene (1.5–3.5 million years ago) (Wadia, 1953). In Burma proper, although the ridges of the Chin hills/Araken Yoma and Pegu Yoma were formed during the Eocene and Miocene respectively, the intervening valleys remained below sea level even during the Pliocene (Krishnan, 1952). When the land links were eventually established the *Pheretima* group could have invaded Peninsula India from the east, but only the more successful peregrine species apparently did so. These occur nowadays throughout much of southern India and they may have attained this distribution unaided but in view of their occurrence on other continents it is likely that they were assisted adventitiously by man. Most of the non-peregrine species of this area remain confined

to the east of the Chindwin-Irrawaddy axis. This faunal limit lies between 100 and 150 km west of a line from the Irrawaddy south to Mandalay to the foot of the Shan plateau to the Sittang valley, i.e. the boundary of the Asian archaean rocks (Rao, 1974 : 238).

In Australia the limiting factors forming the southern boundary of the *Pheretima* group domain are not known precisely but they appear to be largely ecological.

As most Megascolecoidea (Megascolecidae *sensu* Jamieson, 1971a and Eudrilidae) are indigenous on land masses which once formed part of Gondwanaland, it seems likely that they evolved in this region and that their precursors existed in Gondwanaland prior to the Mesozoic break up of this ancient continent. The presence of the *Pheretima* group and other Megascolecoid species in southeast Asia and the occurrence of several genera in North America, is probably due to invasions of these Laurasian land masses from the widely dispersed fragments of Gondwanaland. In this model of Megascolecoid dispersal, the origin of the *Pheretima* group would lie in New Guinea and northern Australia since these are the only major Gondwanaland derived areas inhabited by indigenous species. The invasion of Asia by way of the Indo-Australasian Archipelago could therefore have followed the collision of the Australian and Asian Plates during the Miocene, 7–26 million years ago (Raven & Axelrod, 1972).

If the primordial pheretimoids had emerged before the Mesozoic breakup of Gondwanaland, it would have been possible for them to have migrated westwards to other regions and give rise to the species suspected of being indigenous in the Comoro Islands. However, the absence of any surviving indigenous species in the intervening areas, and the paucity of the *Pheretima* group in the Malagasian fauna, makes this seem unlikely. Emigration may have occurred eastwards to the Solomon Islands, New Hebrides and New Caledonia which, prior to 80 million years ago, were juxtaposed to Queensland (Griffiths, 1971). It should be noted, however, that today the *Pheretima* group is not indigenous in New Zealand although these islands too rifted from the eastern margin of the Australian Plate at that time. Other mechanisms by which earthworms may have colonized oceanic islands were discussed by Stephenson (1930).

Distribution of the 'acaecate' pheretimoids

The individual acaecate genera, although often sympatric, have dissimilar ranges (Fig. 7). *Archipheretima* is restricted to Borneo and the Philippines while the genera *Polypheretima* and *Planapheretima* are the most widespread, occurring throughout the Indo-Australasian archipelago to the northern and western limits of the *Pheretima* group domain. In Asia, they are now restricted to isolated refuges so presumably they were once continuously distributed throughout the area. *Metapheretima* is restricted principally to New Guinea, where it is the commonest acaecate pheretimoid. The monotypic genus *Pleionogaster*, closely allied to *Metapheretima* (see numerical studies) and probably a product of the *Metapheretima* radiation, is recorded only from the Philippines and possibly the Moluccas. The genera *Polypheretima*, *Planapheretima* and *Metapheretima* probably represent three radiations from the Papuan area.

The species-groups comprising the genus *Metapheretima* are largely sympatric and there is seemingly insufficient evidence to recognize any evolutionary patterns among them. Similarly, the ranges and morphological variation of the species of *Archipheretima* are too poorly known to permit valid conclusions to be drawn.

The infra-generic assemblages recognized within *Polypheretima* are, on the other hand, mainly allopatric and when their ranges are considered together with their morphological variations, the information provides a means of tracing the probable evolution of the genus. The species-groups of *Polypheretima* (see taxonomy section) form a series in which the morphological specializations increase as the geographical ranges decrease (Fig. 8). The most widespread, the *bifaria* species-group (Division I), is holandric with simple male pores (the species *grata*, *voeltzkowi* and the *annulata* species-complex, also members of Division I, are considered to be local specializations); the *polytheca* species-group (Division II) is similarly holandric but the male pores open within copulatory pouches; while the most restricted in their distributions, the *badia* and *patae* species-groups (Division III), not only have male pores within copulatory pouches but also they are metandric. Although the *badia* and *patae* species-groups apparently have high mutual affinities (see Taxonomy section), in view of their widely separated ranges, it is probable that they have

developed metandry independently. Possibly the *bifaria*, *polytheca*, *badia* and *patae* species-groups represent successive radiations which occurred in different parts of the range of *Polypheretima*. These radiations are probably of considerable antiquity since the ranges of the species-groups cannot be correlated with either Wallace's or Weber lines. Two species for example, *P. elongata* and *everetti*, even occur on both sides of Wallace's line.

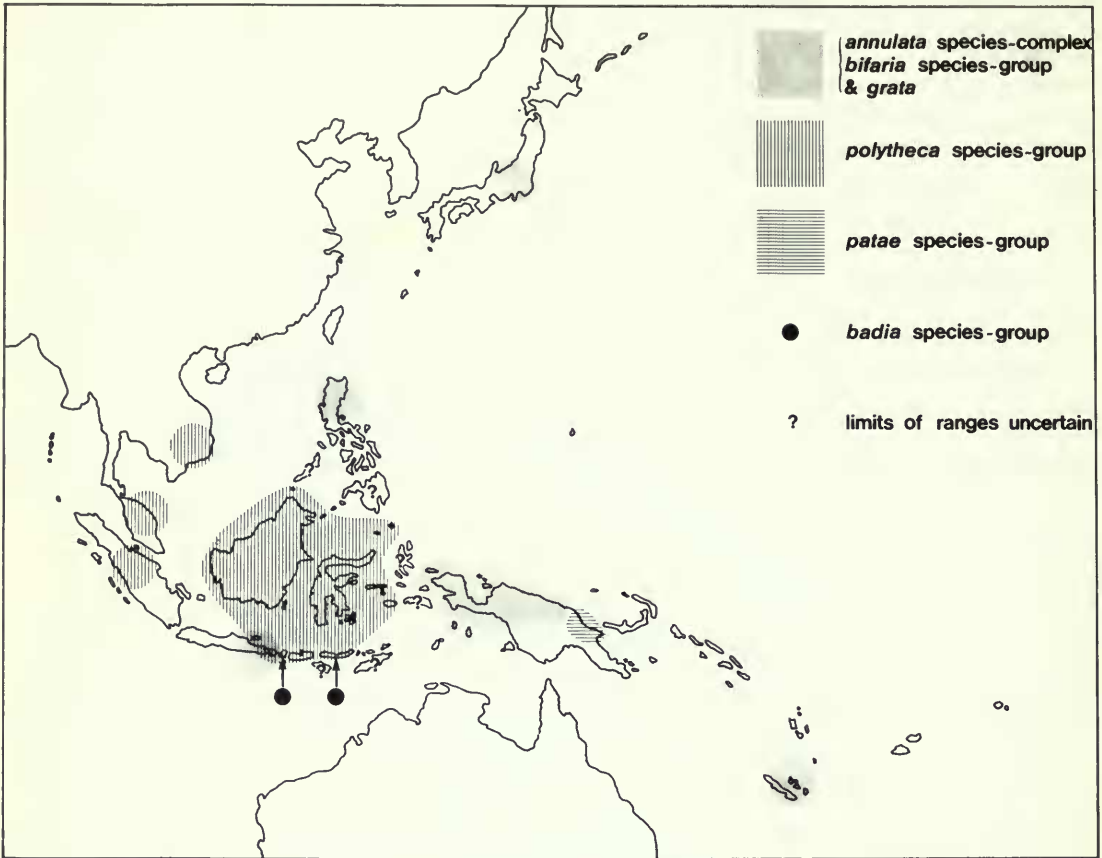


Fig. 8 *Polypheretima*: geographical distribution of the component species-groups.

The two divisions of *Planapheretima* are also allopatric. Species of Division I have unspecialized intestines and occur in the Indo-Australasian archipelago while those of Division II have specialized intestines and are indigenous to the Asian mainland. Probably precursors of Division II had simple intestines but whether this group arose in Asia is more speculative (see taxonomy section).

In the northwestern and southeastern limits of the *Pheretima* group domain the acaecate genera occur only sporadically in isolated refuges, here the *Pheretima* group is represented mainly by the caecate genera *Amyntas*, *Metaphire* and *Pheretima* s.s. Many of the Asian species of *Amyntas* and *Metaphire* differ from species of *Polypheretima* only in the possession of intestinal caecae while most of the Papuan and Australian species of *Amyntas* may be considered to be caecate analogues of *Metapheretima*. Since the possession of intestinal caeca is a specialization, the caecate species may have emerged independently more than once, possibly from this acaecate stock and have replaced them in the northwestern and southeastern parts of the domain.

Classification

For some time the opinion has been often held that 'the key to the classification of the . . . (terrestrial oligochaeta) is to be found in the modifications of the excretory system' (Beddard, 1890*b*). The result is that the structure of the nephridial system has played an increasingly important part in earthworm classifications, although its application often has been hampered by the paucity of available information. During the last two decades several disparate classifications of Megascoleoid earthworms have been proposed (Omodeo, 1958; Gates, 1959; Lee, 1959; Jamieson, 1971*a* & *b*). In the latest Jamieson divided the Megascolecinae, which includes the *Pheretima* group of genera, into three tribes. The tribes Dichogastrini and Megascolecini both include genera with combined male and prostatic pores, and a meronephridial excretory system. In genera assigned to the former tribe the median nephridia are exonephric; while in those of the latter tribe, median nephridia are enteronephric or absent. Enteronephridia have been recorded from no more than five species of the *Pheretima* group of genera; *Metaphire posthuma* by Bahl (1919), *Amyntas hupiensis* by Grant (1955), tentatively in *Pleionogaster horsti* by Gates (1943) and possibly in *Amyntas hawayanus* and *A. diffringens* by Bahl (1919) although the identities of the specimens representing these species have been questioned (Gates, 1937*b*). Jamieson (1971*a*) accepted Bahl's (1946) syllogism that since a few species of *Pheretima* possess enteronephridia so all members of the genus (now the *Pheretima* group of genera) have them too, therefore he assigned the group to the enteronephric tribe Megascolecini.

Due to the importance accredited to the structure of the nephridial system and the paucity of data available for most species of the *Pheretima* group, the nephridial systems of examples of the acaecate genera were examined. Comparisons were made with the description of Bahl (1919) who recognized three types of nephridia in *M. posthuma*.

1. Tufted nephridia, present in the segments anterior to the gizzard and discharging into the pharynx.

2. Body wall nephridia, present in all segments except *i*. These are numerous, Bahl recorded 200–250 in a segment and Grant (1955) reported 175 in each segment in *A. hupiensis*. Bahl reported that in *M. posthuma* each nephridium discharged independently but Beddard (1888) stated that in *A. hawayanus* each nephridium was linked by a reticulum to other nephridia, both of its own and of adjacent segments. [It should be noted that Beddard (1888) provisionally identified the specimens as *aspergillum* but later (1895: 43) he established that they were *bermudensis* = *hawayanus*.] Spencer (1888) reported a similar nephridial reticulum in *Megascolides australis*.

3. Median nephridia, present on septum 15/16 and posteriorly to the end of the body. Eighty to one hundred nephridia are present on the anterior and posterior surfaces of each septum in *M. posthuma* and 70–80 in the case of *A. hupiensis* (Grant, 1955). In both species, the nephridia are enteronephric in that they are linked by paired, postseptal ducts which run dorsally and medianly to discharge into paired suprainestinal ducts, these in turn discharge, at intervals, into the intestine.

In this present study, examples of two species, *Metapheretima sentanensis* and *Polypheretima taprobanae*, were examined in detail and examples of four other species, *M. neoguineensis* (type species of *Metapheretima*), *P. stelleri* (type species of *Polypheretima*), *P. elongata* and *Pleionogaster horsti* (= *jagori*, type species of *Pleionogaster*) were compared with them. The specimens examined had been preserved in alcohol for several years prior to study, so they were stained with methylene blue to enhance the recognition of the decolourized internal structures. Modifications and variations were found in each of the three types of nephridia described above among the species examined (Table 3).

1. Tufted nephridia are present in *iv–vi* in all of the species examined. The nephridia occur as paired lateral masses on the peripheries of the anterior surface of the septa and paired excretory (?) ducts can be traced passing between each nephridial mass and the pharyngeal mass. Additional tufted nephridia are present in *vii* and *viii* in *neoguineensis* and in *vii–ix* in *horsti* and *sentanensis*. When the posterior septa of these segments are absent or incomplete the nephridia form paired lateral bands on the body wall. In *sentanensis* paired excretory (?) ducts can be traced passing from

Table 3 Summary of nephridial types in selected species of the *Pheretima* group

Nephridial types	<i>Metaphire</i>					<i>Polypheretima elongata</i> and <i>stelleri</i>
	<i>posthuma</i> (data from Bahl, 1919)	<i>Metapheretima sentanensis</i>	<i>Metapheretima neoguineensis</i>	<i>Pleionogaster horstii</i>	<i>Polypheretima taprobanae</i>	
Tufted Nephridia	discharging into pharynx	<i>iv-vi</i>	<i>iv-vi</i>	<i>iv-vi</i>	<i>iv-vi</i>	<i>iv-vi</i>
	discharging through body wall	-	<i>vii-ix</i>	<i>vii-viii</i>	<i>vii-ix</i>	-
Body wall Nephridia	simple	<i>ii-pygomere</i> (c. 200/seg)	<i>x-cx</i> (c. 40/seg)	<i>vii-pygomere</i>	<i>x-pygomere</i> (c. 10/seg)	<i>iv-pygomere</i>
	with semi-annular sinuses	-	<i>cx-pygomere</i>	-	-	<i>xc-pygomere</i>
Median Nephridia	presetal	15/16-pygomere (c. 50/septa)	43/44(2)-70/71(40)-90/91(10) sparse on following septa	18/19-pygomere	18/19-pygomere (1 pair/septa)	15/16-pygomere sparse
	postsetal	15/16-pygomere (c. 50/septa)	as presetal but only 10/septa at 70/71	18/19-pygomere	-	-
excretory ducts	enteronephric	not recognized	not recognized	not recognized	not recognized	exonephric

the nephridial masses of *vii* and *viii* forward to enter the body wall in the vicinity of the spermathecal pores. In *xi* where each lateral band is subdivided into three discrete masses, no ducts can be recognized. Gates (1943) first described the tufted nephridia of *vii-ix* in *horsti* and similar structures have been recognized in several species of *Lampito* (Bahl, 1924) and *Megascolex* (Vata, 1945).

2. Body wall nephridia vary in number according to the species and the region of the body studied, they are however always absent from the anteriormost segments. In *horsti* and *sentanensis* they are particularly sparse (*c.* 10 and *c.* 20 per segment respectively). The external nephridiopores described by Beddard (1888) and Bahl (1919) cannot be recognized. The reticulum described by Beddard (1888) appears to be present although transverse microsections need to be studied to confirm this observation.

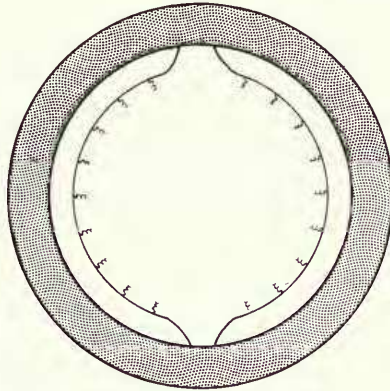


Fig. 9 *Metapheretima sentanensis*: schematic diagram of a transverse section through the equatorial region of a posterior segment showing the semiannular sinuses and associated nephridia.

In the posteriormost segments of two of the specimens examined (*sentanensis* and *taprobanae*) the body wall nephridia of each segment apparently discharge into a pair of semi-annular lateral sinuses (Fig. 9). Excretory ducts leading to external pores are apparently absent. These structures may be analogous to the coelomic pouches of *M. posthuma* described by Beddard & Fedarb (1902), but it is possible that they are artifacts resulting from the epithelial lining of the coelom becoming detached during fixation or preservation.

3. Median nephridia are present in all of the species studied, but their numbers and positions vary from species to species. In *elongata* and *stelleri* they are sparse and close to the body wall and are apparently linked to the reticulum of the body wall nephridia. In *horsti* a single pair of large nephridia with preseptal funnels are present from septum 18/19 and Gates (1943) tentatively recognized a pair of postseptal excretory ducts leading to the dorsal portion of the intestine in each segment. In *taprobanae* there are numerous nephridia with preseptal funnels on each septum from 15/16 to the posterior end of the body. They lie in paired lateral arcs approximately halfway between the intestine and the body wall. In *sentanensis* a single pair of nephridia with preseptal funnels are present on septum 43/44, but the number of nephridia increase posteriorly to septum 70/71 where there are about 40 with preseptal funnels and 20 with postseptal funnels. The nephridia then decrease in number until septum 90/91 where there are about 10 with preseptal funnels and only two or three with postseptal funnels. Where they are reduced in number, the nephridia are dorsally situated. In *neoguinensis*, the nephridia are close to the periphery of each septum, occurring regularly through the body from septum 18/19.

Discussion

From this brief morphological survey it emerges that the nephridial systems of the species examined differ considerably, although they all possess median nephridia. Enteronephric ducts.

diagnostic of the Megascolecini (Jamieson, 1971a & b) and recorded in *Metaphire posthuma* by Bahl (1919) and *Amyntas hupiensis* by Grant (1955), could not be identified in any of the species studied although exonephric ducts, diagnostic of the Dichogastrini (Jamieson, 1971a & b), appear to be present in *Polypheretima elongata* and *P. stelleri*.

As nephridial structures characteristic of two of these different tribes are present within the homogeneous assemblage of species forming the *Pheretima* group of genera, it seems that these structures are unreliable characters for higher classification. If they were accepted, then members of the *Pheretima* group would be distributed between the Dichogastrini and the Megascolecini. Clearly this would be unacceptable. Until new taxonomic criteria can be recognized, or evidence conflicting with the results of the phenetic study become available, it is intended to revert to the older classification of Megascolecoid earthworms proposed by Gates (1959) within which the *Pheretima* group can be more readily accommodated.

The Megascolecidae (Gates, 1959) – ‘species with racemose prostates of the *Pheretima* type, without a central lumen and presumably of mesodermal origin’ – includes the *Pheretima* group of genera (c. 760 nominal species) and about thirteen other genera with approximately 280 species. Similarly, the tribe Megascolecini Jamieson, 1971a & b accommodated ten genera containing about 210 species in addition to the *Pheretima* group. Of the 280 species in the Megascolecidae *sensu* Gates, some 130 are from the Indian region, 130 from Australia and the residue from New Zealand. As previously mentioned, the *Pheretima* group originated on the Australian Plate so its closest allies might be expected to be present among the indigenous Megascolecidae of Australia.

Taxonomy

The component species of the *Pheretima* group of genera are readily distinguishable from the members of the other genera forming the family Megascolecidae (*sensu* Gates, 1959) by the presence of an oesophageal gizzard in segment *viii*. The gizzard is usually well developed to the extent that it often lies within the parietes of not only segment *viii* but also segments *ix* and *x*. In *Pleionogaster*, however, the oesophageal gizzard is only vestigial and here it is replaced functionally by intestinal gizzards which are diagnostic of the genus. Additionally all pheretimoids are perichaetine.

The species of this group of genera form two loose assemblages; those with a pair of lateral caeca or a single median caecum arising from the anterior region of the intestine, and those without this specialization. The latter category, the ‘acaecate’ species are revised here and assigned to five genera: *Archipheretima*, *Metapheretima* (inc. *Ephmitra*), *Planapheretima*, *Pleionogaster* and *Polypheretima*. On the basis of the numerical investigations described above and detailed under the genera concerned, the species are often placed in divisions and species-groups also, in two instances, species-complexes are recognized. Some of these infra-generic categories may represent superspecies while others may, in time, be considered to represent subgenera, but until further information becomes available, they should be regarded as being no more than aggregations of morphologically similar species placed together to facilitate identification. They are not co-ordinate, even within any one genus. One of the species-complexes recognized was erected to contain five closely allied taxa comprising the *Polypheretima elongata* species-complex (Easton, 1976). At the present time the mutual relationships of these taxa are unknown, in many ways the complex resembles a polytypic species.

The majority of acaecate species are known from only one or two series, and whenever possible examples of all known records have been examined in this study. The following abbreviations have been utilized to denote the institution in which material is deposited.

Adelaide	South Australian Museum
Amsterdam	Zöologisch Museum, Universitat van Amsterdam
Berlin	Museum für Naturkunde an der Humbolt-Universität zu Berlin
Bogor	Museum Zoologicum Bogoriense, Bogor, Indonesia
BMNH	British Museum (Natural History)
Cambridge	University Museum of Zoology, Cambridge, England
Genoa	Museo Civico di Storia Naturale ‘Giacomo Doria’

Hamburg	Zoologisches Institut und Zoologisches Museum, Universität Hamburg
Honolulu	Bernice P. Bishop Museum
Leiden	Rijksmuseum van Natuurlijke Historie
New York	American Museum of Natural History
Stockholm	Naturhistoriska Riksmuseet
Turin	Museo ed Instituto di Zoologica Systematica, Università di Turin
Vienna	Naturhistorisches Museum Wien

Aclitellate and clitellate individuals among the material examined are indicated by the letters A and C respectively.

Key to the genera of the *Pheretima* group

1	Setae crowded ventrally, creeping sole present, body usually flattened dorsoventrally	<i>Planapheretima</i> (p. 64)
	Setae not crowded ventrally, creeping sole absent, body always cylindrical	2
2	Intestine lacking caecum(a) or gizzards	3
	Intestine with gizzards	<i>Pleionogaster</i> (p. 114)
	Intestine with caecum(a)	5
3	Crescentic markings associated with male pores (Fig. 4c)	<i>Metapheretima</i> (p. 78)
	Crescentic markings absent	4
4	Clitellum extending over more than three segments; spermathecal diverticula multilocular	<i>Archipheretima</i> (p. 21)
	Clitellum restricted to three segments, spermathecal diverticula simple	<i>Polypheretima</i> (p. 28)
5(2)	Intestinal caecum(a) originating in or near segment <i>xxii</i>	<i>Pithemera</i> ¹
	Intestinal caecum(a) originating in or near segment <i>xxvii</i>	6
6	Male pores simple	<i>Amynthas</i> ¹
	Male pores within copulatory pouches	7
7	Nephridia on spermathecal ducts	<i>Pheretima</i> ¹
	Nephridia absent from spermathecal ducts	<i>Metaphire</i> ¹

¹ For keys to the nominal species and species-groups of the 'caecate' genera, *Amynthas*, *Metaphire*, *Pheretima* and *Pithemera*, see Sims & Easton (1972). For species transferred to these genera since 1972 see below (p. 119).

ARCHIPHERETIMA Michaelsen, 1928

Megascolex (part): Beddard, 1895 : 370.

Amynthas (part): Beddard, 1900a : 612.

Pheretima (part): Michaelsen, 1900 : 234.

Pheretima (*Archipheretima*) (part) Michaelsen, 1928a : 7.

Pheretima (*Archipheretima*): Michaelsen, 1934b : 15.

Archipheretima: Sims & Easton, 1972 : 200, 232.

TYPE SPECIES. *Megascolex iris* Michaelsen, 1892, original designation.

DIAGNOSIS. Megascolecidae with an oesophageal gizzard in *viii*, intestinal caeca and gizzards absent. Body cylindrical, setae never excessively crowded ventrally, creeping sole absent. Male pores superficial or on circular porophores, never within copulatory pouches. Spermathecal diverticula multilocular.

DESCRIPTION. Body cylindrical. Clitellum annular, extending over four or more segments in mature individuals (*xii*, *xiii*-*xvi*, *xvii*, *xviii*). Dorsal pores present from 12/13. Setae perichaetine with large dorsal gaps (up to 0.25 body circumference), often slightly crowded ventrally. Lateral hearts in *x*-*xii* and sometimes *xiii*.

Oesophagus with a well-developed gizzard in *viii*, lacking dorsal pouches and calciferous glands. Intestine begins between *xv* and *xvii*, simple, lacking caeca, gizzards and glandular walls.

Holandric, testes free (?) or in large, delicate sacs lining the coelom and usually enclosing the anterior seminal vesicles, the lateral hearts and other vessels. Seminal vesicles paired in *xi* and *xii*.

Prostates racemose. Paired, combined male and prostatic pores on the ventral surface of *xviii* in the setal ring. Male pores occasionally on porophores which may be elongate and extend onto

xix and *xx*. Copulatory pouches absent. Ovaries free. Oviducts leading to single or closely paired midventral equatorial pore(s) on *xiv*. Spermathecae only slightly differentiated into duct and ampulla; each with a short multilocular diverticulum. Spermathecae arranged in pairs in three or four adjacent segments between *v* and *ix*. Spermathecal pores always intersegmental, small, often slitlike, ventral or ventrolateral.

Genital markings of two kinds have been recorded; discrete paired, ovoid segmental markings and diffuse intersegmental markings. The porophores extending from *xviii* to *xx* in some species may be confused with genital markings.

DISTRIBUTION. Borneo, Philippines.

INCLUDED SPECIES. *iris* species-group (*iris*, *margaritacea*, *mazarredi*, *zonata*), *ophiodes*, *picta*.

NUMERICAL STUDIES. In the initial computer study (see above) the affinities of the species as revealed by the MST and their configuration on the first and second vectors (Fig. 6) provide the basis for the recognition of two distinct species and one species-group.

REMARKS. Although a key is provided for the identification of species included in the genus *Archipheretima*, mature individuals may be readily assigned to their species or species-group on the form of their genital markings (Figs 11 and 12). The species *tumifaciens* (Lee, 1967) which was provisionally included in *Archipheretima* by Sims & Easton (1972) is now transferred to *Meta-pheretima* as a synonym of *M. jochana* (Cognetti, 1911).

Key to the species of the genus *Archipheretima*

- | | | |
|------|--|-----------------------------|
| 1 | First spermathecal pores in furrow 4/5 (3 thecal segments) | <i>ophiodes</i> (p. 27) |
| | First spermathecal pores in furrow 5/6 (4 thecal segments) | 2 |
| | First spermathecal pores in furrow 6/7 (3 thecal segments) | 4 |
| 2 | Spermathecal pores closely paired (0.05 body circumference apart) | <i>zonata</i> (p. 23) |
| | Spermathecal pores widely paired (0.20–0.30 body circumference apart) | 3 |
| 3 | Male pore small, indistinct (Philippines) | <i>mazarredi</i> (p. 23) |
| | Male pore at centre of large porophore (Borneo) | <i>picta</i> (p. 26) |
| 4(1) | Spermathecal pores <i>c.</i> 0.05 body circumference apart (preclitellar genital markings absent) | |
| | | <i>iris</i> (p. 26) |
| | Spermathecal pores <i>c.</i> 0.10 body circumference apart (preclitellar genital markings present) | |
| | | <i>margaritacea</i> (p. 25) |

Archipheretima iris species-group

DIAGNOSIS. *Archipheretima* with poorly defined intersegmental genital markings and simple male pores.

DISTRIBUTION. Borneo and Philippines.

SPECIES INCLUDED. *iris*, *margaritacea*, *mazarredi*, *zonata*.

REMARKS. Juvenile and other individuals with poorly developed genital markings may be distinguished from *picta* by the absence of a porophore and from *ophiodes* by the presence of spermathecal pores in furrow 7/8. Marker characters of the species included in the *iris* species-group are given in Table 4.

Archipheretima mazarredi (Rosa, 1894)

Megascolex mazarredi Rosa, 1894 : 6.

Amyntas mazarredoi: Michaelsen, 1899 : 15; Beddard, 1900a : 644.

Pheretima mazarredoi: Michaelsen, 1900 : 283; Gates, 1970a : 155.

Archipheretima mazarredoi: Sims & Easton, 1972 : 232.

DIAGNOSIS. *Archipheretima* with spermathecal pores about one fifth of the body circumference apart in furrows 5/6/7/8/9. Genital markings poorly defined, intersegmental.

DESCRIPTION. *External characters*. Length 200–325 mm, diameter 13–15 mm. 105–131 segments. Clitellum *xiii*–*xvi*. First dorsal pore 12/13. Setae *c.* 100 on *xxv*, setal ring crowded ventrally.

Table 4 Marker characters of the members of the *Archipheretima iris* species-group

Species	Spermathecal furrows	Separation of spermathecal pores	Setal No. on <i>vii</i>	Genital markings	Distribution
<i>mazarredi</i>	5/6/7/8/9	0.20	c. 100	postclitellar	Marinduque Is. Philippines
<i>zonata</i>	5/6/7/8/9	0.05	c. 94	postclitellar	Borneo
<i>margaritacea</i>	6/7/8/9	0.10	c. 28	preclitellar and postclitellar	Samar Is. Philippines
<i>iris</i>	6/7/8/9	0.05	34-40	postclitellar	Samar Is. Philippines

Male pores c. 0.20 body circumference apart. Female pore single. Spermathecal pores paired, 5/6/7/8/9, c. 0.20 body circumference apart.

Genital markings (Fig. 11a) diffuse, paired, intersegmental in line with the male pores in 17/18 and 18/19, 19/20, 20/21.

Internal characters. Septa anterior to 17/18 thickened. Intestine begins in *xvii*. Lateral hearts in *x-xiii*.

Holandric, testes in *x* and *xi*, testes sacs membranous or absent, seminal vesicles in *xi* and *xii*. Spermathecae (Fig. 10a) paired in *vi-ix*.

Description after Rosa (1894) and Gates (1970). Fig. 11a is an interpretation of the genital field based on the written descriptions.

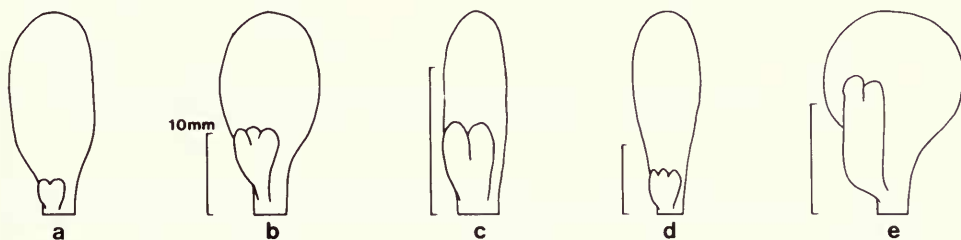


Fig. 10 Spermathecae. (a) *Archipheretima mazarredi*; (b) *A. zonata*; (c) *A. margaritacea*; (d) *A. iris*; (e) *A. picta*. Scales 1 mm unless otherwise indicated.

DISTRIBUTION. Marinduque Island, Philippines.

REMARKS. The correct spelling of the name *mazarredi* has been the subject of confusion. The original orthography, *mazarredi*, was changed by Michaelsen (1900) to *mazarredo*, an unjustified emendation (Article 33, *Int. Code zool. Nomencl.*) which has been used by subsequent authors.

RECORDS. 1C Marinduque Island, Philippines (holotype of *mazarredi*). It has not been possible to locate the holotype of this species. It is absent from the collection of the Museo Nacional de Ciencias Naturales, Madrid, where Gates (1970) suggested that it may be found: Dr J. Alvarez, personal communication. 7A Marinduque Island, Philippines (*mazarredi*: Gates, 1970).

Archipheretima zonata (Michaelsen, 1922)

Pheretima zonata Michaelsen, 1922 : 42.

Pheretima (Archipheretima) zonata: Michaelsen, 1928a : 11; Michaelsen, 1934b : 15.

Archipheretima zonata: Sims & Easton, 1972 : 181, 232.

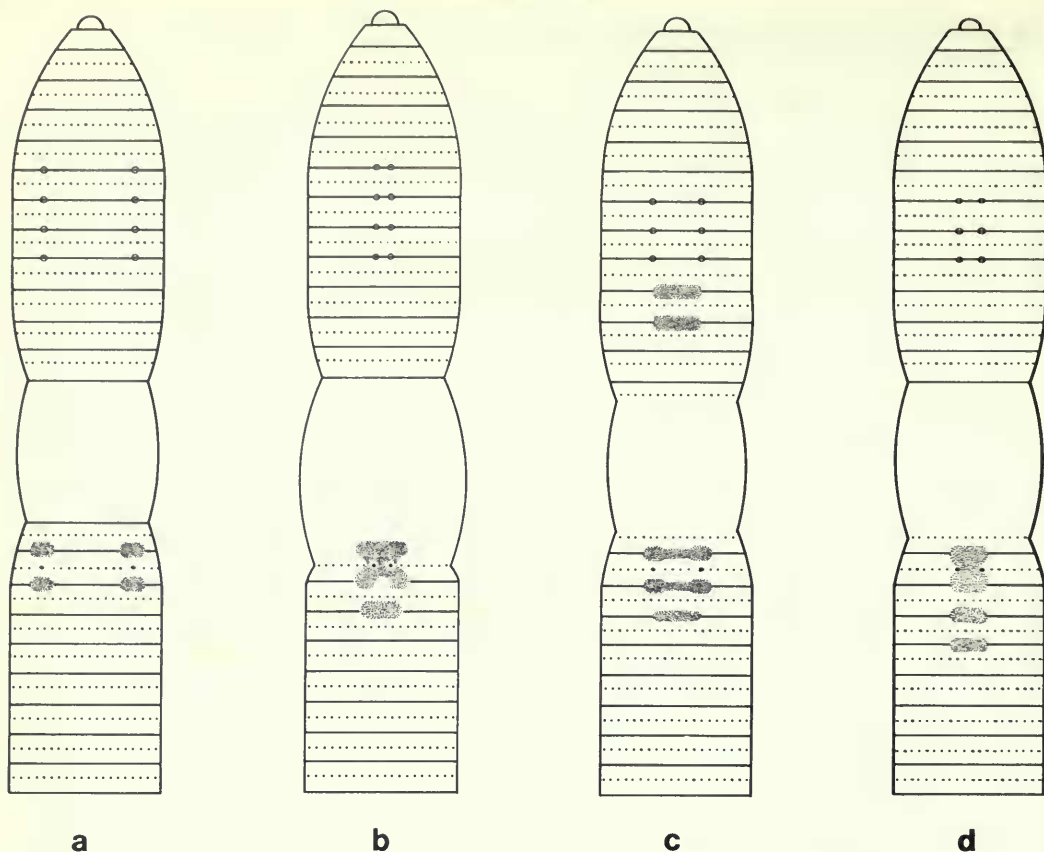


Fig. 11 Anterior ventral surface, diagnostic characters. (a) *Archipheretima mazarredi*; (b) *A. zonata*; (c) *A. margaritacea*; (d) *A. iris*.

Pheretima (Archipheretima) penrisseni Michaelsen, 1928a : 11; Michaelsen, 1934b : 15.
Archipheretina penrisseni: Sims & Easton, 1972 : 232.

DIAGNOSIS. *Archipheretima* with spermathecal pores about one twentieth of the body circumference apart in furrows 5/6/7/8/9. Genital markings poorly defined, intersegmental.

DESCRIPTION. *External characters*. Length 190–360 mm, diameter 10–15 mm. 124–147 segments. Clitellum $\frac{1}{2}$ xiii– $\frac{1}{2}$ xviii. First dorsal pore 12/13. Setae 90–94 on vii, 84–96 on xx. Setal ring slightly crowded ventrally on preclitellar segments ($aa=ab=0.6yz=0.6zz$), and with dorsal gaps on postclitellar segments ($aa=ab=0.6yz=0.3zz$).

Male pores simple, $c. 0.05$ body circumference apart. Female pore single or paired. Spermathecal pores small, paired, 5/6/7/8/9, $c. 0.04$ body circumference apart.

Genital markings (Fig. 11b), single or paired, intersegmental in 17/18, 18/19, 19/20.

Internal characters. Septa 5/6–7/8 thickened, 8/9 membranous, 9/10–13/14 thickened. Intestine begins in xvi. Lateral hearts in x–xii.

Holandric, testes sacs annular, enclosing the lateral hearts, in x and, in xi the anterior seminal vesicles as well. Spermathecae (Fig. 10b) paired in vi–ix.

DISTRIBUTION. Borneo.

REMARKS. Genital markings are absent from the holotype of *zonata* while the clitellum has not developed to its full length in the holotype of *penrisseni*. These differences are probably attributable to differential rates of achieving maturity.

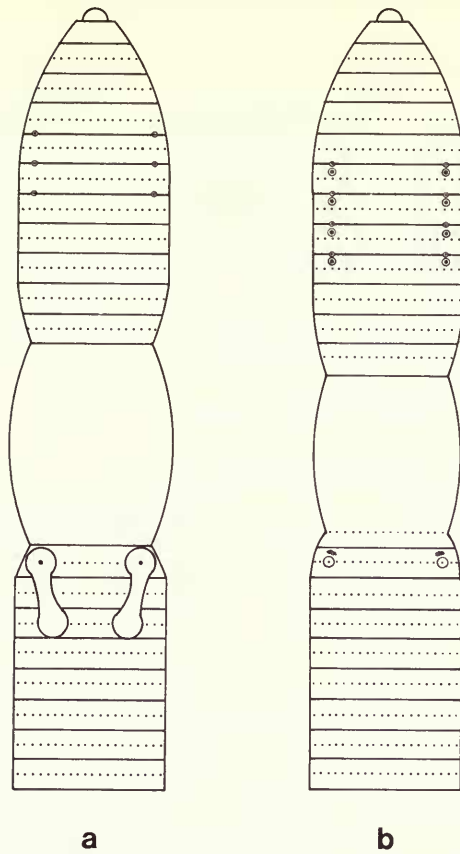


Fig. 12 Anterior ventral surface, diagnostic characters. (a) *Archipheretima ophioides*; (b) *A. picta*.

MATERIAL EXAMINED. 1C Nangaraun, Kalimantan; Leiden 1816 (holotype of *zonata*). 1C Mt Penrissen, Sarawak; Hamburg v10513 (holotype of *penrissenii*).

Archipheretima margaritacea (Michaelsen, 1892)

Megascolex margaritacea Michaelsen, 1892 : 245; Beddard, 1895 : 383.

Amyntas margaritacea: Michaelsen, 1899 : 16; Beddard, 1900a : 647.

Pheretima margaritacea: Michaelsen, 1900 : 282.

Pheretima (Archipheretima) margaritacea: Michaelsen, 1934b : 15.

Archipheretima margaritacea: Sims & Easton, 1972 : 232.

DIAGNOSIS. *Archipheretima* with spermathecal pores about one tenth of the body circumference apart in furrows 6/7/8/9. Genital markings poorly defined, intersegmental in furrows 9/10, 10/11, 12/13 and in postclitellar furrows.

DESCRIPTION. *External characters*. Length *c.* 90 mm, diameter *c.* 5 mm. 85–103 segments. Clitellum $\frac{1}{2}$ xiii– $\frac{1}{2}$ xvii. First dorsal pore 12/13. Setae, *c.* 28 on vii, *c.* 28 on xx, setal ring regular on preclitellar segments with dorsal and ventral gaps ($aa=2ab=2yz=0.5zz$), slightly crowded ventrally with dorsal and ventral gaps on postclitellar segments ($aa=2ab=yz=0.5zz$).

Male pores simple, *c.* 0.10 body circumference apart. Female pores paired. Spermathecal pores small transverse slits, 6/7/8/9, *c.* 0.10 body circumference apart.

Genital markings (Fig. 11c), diffuse, unpaired, median, intersegmental in 10/11, 17/18, 18/19, 19/20 and occasionally 9/10 and 12/13.

Internal characters. Not known. Spermathecae (Fig. 10c) paired in *vii-ix*.

DISTRIBUTION. Samar Island, Philippines.

REMARKS. Michaelsen (1892) did not describe the internal morphology of this species. All the internal structures in the anterior region except the spermathecae have been removed from the surviving syntype by previous dissection. It is probable that the internal anatomy of this species resembles that of *iris*.

MATERIAL EXAMINED. 1A (lacking anterior portions of gut and anterior male reproductive organs) Loquilocon, Samar Island, Philippines; Hamburg v361 (syntype of *margaritacea*).

OTHER MATERIAL. Data as above; Berlin 2134 (syntype(s) of *margaritacea*). This material could not be located during the preparation of this report: Dr G. Hartwich, personal communication.

Archipheretima iris (Michaelsen, 1892)

Megascolex iris Michaelsen, 1892 : 244; Beddard, 1895 : 383.

Amyntas iris: Michaelsen, 1899 : 15; Beddard, 1900a : 647.

Pheretima iris: Michaelsen, 1900 : 276.

Pheretima (Archipheretima) iris: Michaelsen, 1928a : 8; Michaelsen, 1934b : 15.

Archipheretima iris: Sims & Easton, 1972 : 200, 232.

DIAGNOSIS. *Archipheretima* with spermathecal pores about one twentieth of the body circumference apart in furrows 6/7/8/9. Genital markings poorly defined, intersegmental in postclitellar furrows only.

DESCRIPTION. *External characters.* Length 170–240 mm, diameter 7–9 mm. 110–116 segments. Clitellum *xiii*– $\frac{1}{2}$ *xvii*. First dorsal pore 12/13. Setae, 34–40 on *vii*, 42–46 on *xx*, setal ring slightly crowded ventrally with dorsal and ventral gaps ($aa = 2ab = yz = 0.25zz$).

Male pores simple, *c*. 0.05 body circumference apart. Female pore single. Spermathecal pores paired, small transverse slits, 6/7/8/9, *c*. 0.05 body circumference apart.

Genital markings (Fig. 11d) diffuse unpaired, median, intersegmental in 17/18, 18/19, 19/20, 20/21.

Internal characters. Septa 6/7–12/13 membranous. Intestine begins in *xvii*. Lateral hearts in *x-xiii*.

Holandric, testes sacs large, annular in *x* and *xi*, enclosing the lateral hearts and in *xi* the seminal vesicles as well, seminal vesicles small, extending to the lateral line. Spermathecae (Fig. 10d) paired *vii-ix*.

DISTRIBUTION. Samar Island, Philippines.

REMARKS. The description differs in some details from those of earlier authors (Michaelsen, 1892; Sims & Easton, 1972). Michaelsen recorded the number of segments in this species as 240, neither of the clitellate specimens examined had more than 116 segments, but both approached the maximum length of 240 mm recorded by Michaelsen. Sims and Easton recorded the separation of the male and spermathecal pores as 0.25 but an examination of the type series confirmed that the value should be 0.05 as contained in the original description.

MATERIAL EXAMINED. 2C, 2A Loquilocon, Samar Island, Philippines; Berlin 565 (syntypes of *iris*). 1A Data as above; Turin 01 122 (syntype of *iris*).

Archipheretima picta (Michaelsen, 1892)

Megascolex pictus Michaelsen, 1892 : 246; Beddard, 1895 : 384.

Amyntas pictus: Michaelsen, 1899 : 83; Beddard, 1900a : 623.

Pheretima picta: Michaelsen, 1900 : 294.

Pheretima (Archipheretima) picta: Michaelsen, 1928a : 10; Michaelsen, 1934b : 15.

Archipheretima picta: Sims & Easton, 1972 : 230.

Pheretima beccarii Cognetti, 1909 : 331.

Pheretima (Archipheretima) beccarii: Michaelsen, 1928a : 11.

Archipheretima beccarii: Sims & Easton, 1972 : 230.

DIAGNOSIS. *Archipheretima* with spermathecal pores about one quarter of the body circumference apart in furrows 5/6/7/8/9. Male pores on circular porophores. Genital markings ovoid, paired, presetal on *vi-ix* and *xviii*.

DESCRIPTION. *External characters.* Length 240–260 mm, diameter, 5–9 mm. 137–146 segments. Clitellum *xiii-½xviii*. First dorsal pore 12/13. Setae, *c.* 74 on *vii*, *c.* 77 on *xx*, setal ring regular with dorsal gaps on preclitellar segments ($aa=ab=yz=0.3zz$), slightly crowded ventrally with dorsal and ventral gaps on postclitellar segments ($aa=2ab=yz=0.3zz$).

Male pores on circular porophores *c.* 0.29 body circumference apart. Female pore single. Spermathecal pores small in 5/6/7/8/9 *c.* 0.27 body circumference apart.

Genital markings (Fig. 12b) paired, presetal, in line with the spermathecal pores, on *vi-ix*, anterior to the male pores on *xviii*.

Internal characters. Septa 5/6/7/8 slightly thickened, 8/9 absent, 9/10–13/14 slightly thickened. Intestine begins in *xv*. Lateral hearts in *x-xiii*.

Holandric, testes sacs annular in *x* and *xi*, seminal vesicles large, extending to the dorsal line in *xi* and *xii*, those of *xi* enclosed in the posterior testes sacs. Spermathecae (Fig. 10e) paired in *vi-xi*.

DISTRIBUTION. Borneo.

REMARKS. The original description of *picta* did not contain details of the genital markings or mention of intestinal caeca. Later Michaelsen (1900 : 248) was uncertain whether *picta* possessed intestinal caeca, although finally he included it in the subgenus *Archipheretima* (1928 : 10). In the absence of typical material, it is proposed to accept Michaelsen's decision since the other characters he listed, length of clitellum and form of spermathecal diverticula, support the inclusion of the species in *Archipheretima*.

The holotype of *beccarii* agrees closely with the description of *picta*, being distinguishable only by a shorter clitellum and the presence of genital markings. These differences are probably attributable to varying stages of development.

MATERIAL EXAMINED. 1C Sarawak; Genova 44045 (holotype of *beccarii*).

OTHER RECORDS. 1C Sampit, Kalimantan; Berlin 554 (holotype of *picta*). This specimen is listed in the catalogue of the Berlin Museum but it could not be located during the preparation of this paper: Dr G. Hartwich, personal communication.

Archipheretima ophiodes (Michaelsen, 1929)

Pheretima (Archipheretima) ophiodes Michaelsen, 1929 : 85; Michaelsen, 1930a : 273; Michaelsen, 1934b : 15.

Archipheretima ophiodes: Sims & Easton, 1972 : 230.

DIAGNOSIS. *Archipheretima* with spermathecal pores in furrows 4/5/6/7. Male pores on raised porophores extending from *xviii* to *xx*.

DESCRIPTION. *External characters.* Length 245–300 mm, diameter 13–20 mm. 106–118 segments. Clitellum *xii-xvii*. First dorsal pore 12/13. Setae, *c.* 60 on *vii*, *c.* 67 on *xxvi*, *c.* 72 on *xxx*, setal ring crowded ventrally with very large dorsal gaps ($zz=0.25$ body circumference).

Male pores simple, on raised porophores extending from *xviii* to *xx* (Fig. 12a), separation not recorded. Female pores paired. Spermathecal pores in 4/5/6/7, *c.* 0.33 body circumference apart.

Genital markings absent.

Internal characters. All anterior septa present and delicate. Beginning of intestine not recorded. Lateral hearts in *x-xiii*.

Holandric, testes sacs in x and xi , details not recorded. Seminal vesicles in xi and xii , simple, thin. Spermathecae paired in $v-vii$, ampulla sack-like or pear-shaped, not differentiated into ampulla and duct, diverticula small, globular.

Description after Michaelsen (1929, 1930); and the author after the examination of the remains of a syntype.

DISTRIBUTION. Luzon, Philippines.

MATERIAL EXAMINED. The gizzard, oesophagus, part of the intestine and part of the anterior male reproductive system (the body wall has not survived). Mt Azapan, Luzon, Philippines; Hamburg v10418 (remains of syntype of *ophiodes*).

POLYPHERETIMA Michaelsen, 1934

Megascolex (*Perriera*) (part) Vaillant, 1889 : 63.

Perichaeta (part): Beddard, 1895 : 388.

Amyntas (part): Beddard, 1900a : 612.

Pheretima (part): Michaelsen, 1900 : 234.

Pheretima (*Parapheretima*) (part) Cognetti, 1912 : 556; Michaelsen, 1928a : 8.

Pheretima (*Pheretima*) (part): Michaelsen, 1928a : 8.

Pheretima (*Metapheretima*) (part): Michaelsen, 1928a : 8.

Metapheretima (part): Sims & Easton, 1972 : 205, 233.

Pheretima (*Polypheretima*) (part) Michaelsen, 1934b : 15.

TYPE SPECIES. *Perichaeta stelleri* Michaelsen, 1892, original designation.

DIAGNOSIS. Megascolecidae with an oesophageal gizzard in $viii$, intestinal caeca and gizzards absent. Body cylindrical, setae never excessively crowded ventrally, creeping sole absent. Male pores on circular porophores which may be within copulatory pouches. Crescentic genital markings absent. Spermathecal pores small, spermathecal diverticula simple and usually ectal in origin.

DESCRIPTION. Body cylindrical, creeping sole absent. Clitellum annular, restricted to three segments ($xiv-xvi$). First dorsal pore between $5/6$ and $12/13$. Setae perichaetine, never excessively crowded ventrally, dorsal and ventral gaps small ($aa=1-2ab$, $zz=1-2yz$). Lateral hearts in $x-xii$ and sometimes $xiii$.

Oesophagus with a well-developed gizzard in $viii$ but lacking calciferous glands and dorsal pouches. Intestine begins in xv or xvi , simple, lacking caeca, gizzards and glandular walls.

Usually holandric, occasionally metandric, ? never proandric - testes may be restricted to x in *sibogae* which is known only from the damaged holotype. The testes of each segment are enclosed in single or paired stout sacs which usually occupy most of the coelom and often enclose the anterior seminal vesicles and the lateral hearts of x and xi . One pair of seminal vesicles in the segment directly posterior to each pair of testes. Prostates racemose. Paired combined male and prostatic pores on the ventral surface of $xviii$ in the setal ring. Male pores situated on circular porophores, often within copulatory pouches. The porophores bearing the male pores are short and stout (cf. penial bodies in *Metapheretima*) while the openings to the copulatory pouches, when present, are often crescentic (Figs 3a-f). Ovaries free in $xiii$. Oviducts lead to single or closely paired, midventral, equatorial pore(s) on xiv . Spermathecae each differentiated into duct and ampulla, diverticula simple and ectal in origin, usually as long or longer than main duct and ampulla. Spermathecae arranged in pairs or paired batteries of up to 28 spermathecae, in one to five adjacent segments between v and ix . Spermathecal pores small, usually intersegmental, rarely segmental.

Genital markings always of the discrete type, diffuse genital markings and annular ridges absent. When present on $xviii$ the genital markings are identical to those of adjacent segments; they are never crescentic and closely associated with the male pores. The arrangement of genital markings is variable. The glandular tissue associated with the genital markings may be restricted to the body wall or invade the coelom in the form of stalked glands. The area around the male pores may be infrequently elevated above the body surface.

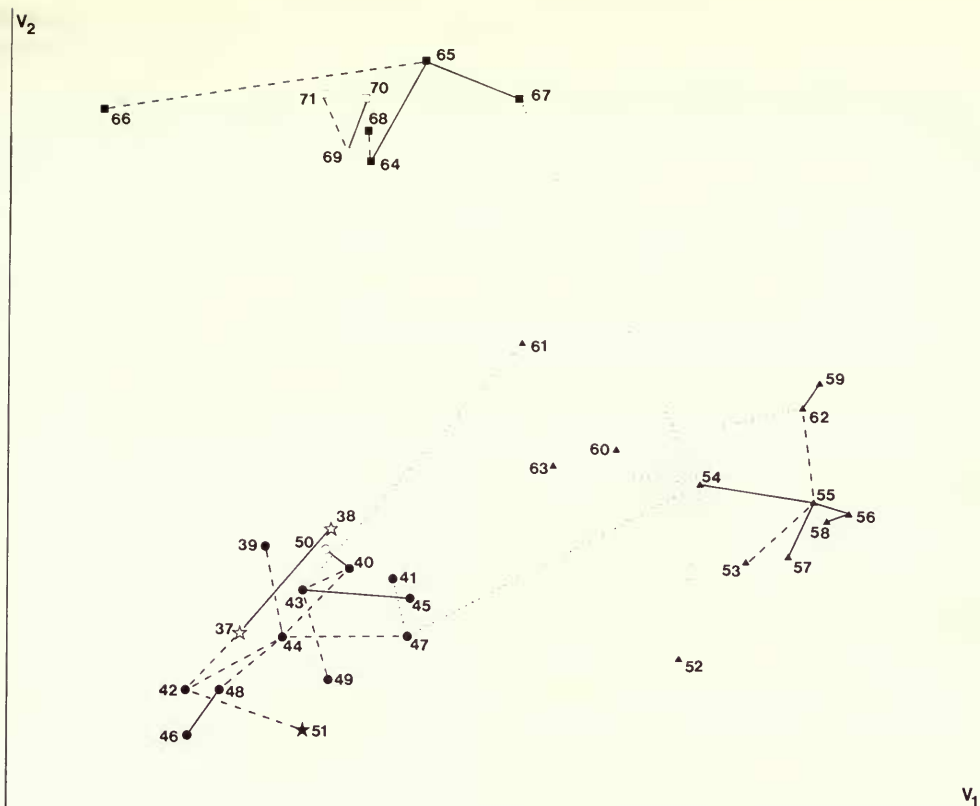


Fig. 13 Principal co-ordinates analysis of 35 species here assigned to *Polypheretima* (37–71 of Table 1): the configuration of species with the vectors corresponding to the first and second latent roots. The linkages of the added MST are graded to indicate percentage similarities; —, +95%; - - - - , 90–95%; ····, -90%. Three major assemblages are recognized: Division I – circular and star-shaped symbols (closed circles – *bifaria* species-group, open circle – *grata*, closed stars – *annulata* species-complex, open star – *voeltzkowi*). Division II – triangular symbols (*polytheca* species-group). Division III – square symbols (closed squares – *badia* species-group, open squares – *patae* species-group).

DISTRIBUTION. (Fig. 8.) Autochthonous species have been recorded throughout the *Pheretima* group domain except from New Britain, the Solomon Islands, New Hebrides, Caroline Islands and Marianas.

NUMERICAL STUDIES. The taxa of the genus *Polypheretima* listed in Table 1 (37–71) were subjected to a numerical analysis utilizing the characters listed in Table 2. The configuration of the taxa with the first and second vectors of the principal co-ordinates analysis as axes, to which the MST with graded linkages has been added, is shown in Fig. 13. Three divisions, indicated by circular, triangular and square symbols, may be recognized. The division to which the species *pentacystis* (61) should be assigned requires discussion. From its position on the first and second vectors it would appear to belong to Division II (triangular symbols), although it is linked by the MST to Division I (circular symbols). Since this species possesses several characters diagnostic of Division II as well as having several nearest neighbours among the taxa of this division, it is proposed to include *pentacystis* in Division II.

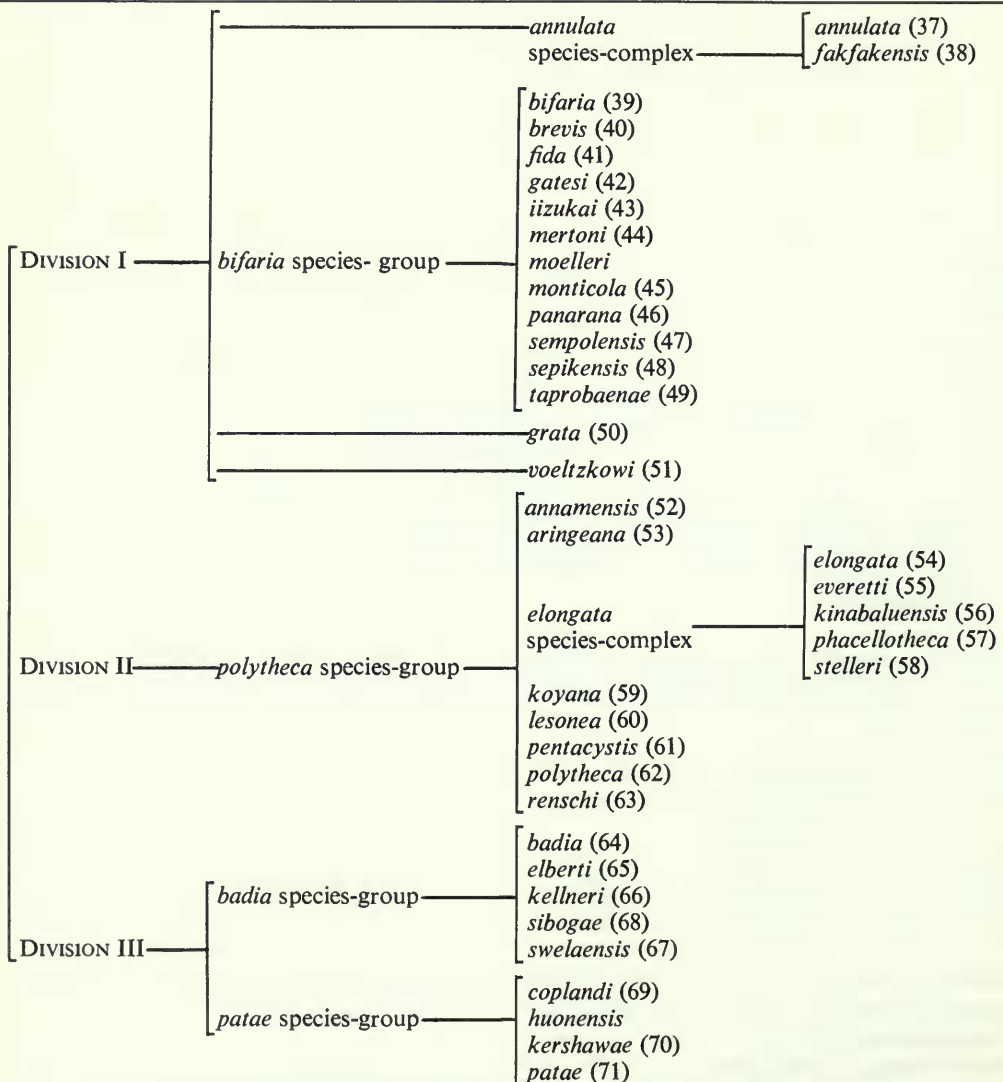
Morphologically the three divisions are readily defined. All holandric taxa are accommodated in Divisions I and II while metandric species form Division III (square symbols). With the exception of the species *grata* (50) all the members of Division I have simple male pores while those of

Division II have male pores within copulatory pouches. The copulatory pouches of *grata* differ from those of members of Division II in that stalked glands discharge into them in addition to the male pores.

An examination of all of the vectors available for study failed to reveal the presence of subordinate clusters within Division I. Nevertheless it is convenient to recognize a species group, a species-complex and two species within this division. The individual species are *grata* (50) discussed above and *voeltzkowi* (51) with postsetal spermathecal pores. The members of the *annulata* species complex, *annulata* (37) and *fakfakensis* (38), have presetal spermathecal pores. The *bifaria* species-group is recognized by the possession of simple male pores and intersegmental spermathecal pores.

All of the taxa in Division II are assigned to the *polytheca* species-group. Included in this species-group are taxa 54–58 the *elongata* species-complex which are linked by the MST at very high levels.

Table 5 Phenetic classification and checklist of the genus *Polypheretima*



Numbers in parentheses indicate taxa assessed in numerical studies (see Figs 6 and 13).

The taxa forming Division III can be readily divided into two clusters, indicated by open and closed square symbols, on the position of the species along the third vector (not shown here) and by application of the MST. The cluster indicated by solid square symbols, the *badia* species-group, comprises taxa from the Lesser Sunda Islands, these have a single pair of genital markings on each of several postclitellar segments. While the clusters indicated by open square symbols, the *patae* species-group, contains taxa from New Guinea with numerous genital markings arranged in transverse rows on several postclitellar segments.

A summary of the phenetic classification based on this numerical investigation is given in Table 5.

Key to the species of the genus *Polypheretima*

1	Proandric	<i>sibogae</i> ¹ (p. 58)
	Holandric	2
	Metandric	21
2	Male pores simple	3
	Male pores in copulatory pouches	13
3	Spermathecal pores segmental	4
	Spermathecal pores intersegmental	5
4	Spermathecal pores presetal (<i>vii, viii</i> or <i>vii, viii, ix</i>) ²	<i>annulata</i> species-complex (p. 34)
	Spermathecal pores postsetal (<i>v</i> only)	<i>voeltzkowi</i> (p. 47)
5(3)	First spermathecal pores in furrow 4/5	6
	First spermathecal pores in furrow 5/6	7
	First spermathecal pores in furrow 6/7	12
	First spermathecal pores in furrow 7/8 (one thecal segment) ³	<i>taprobanae</i> (p. 45)
6	Two or three thecal segments ⁴	<i>fida</i> (p. 37)
	Five thecal segments	<i>moelleri</i> (p. 38)
7(5)	Two thecal segments	8
	Three thecal segments	10
	Four thecal segments ⁵	11
8	One pair of genital markings per segment (Java)	<i>sempolensis</i> (p. 39)
	Two or more pairs of genital markings per segment (New Guinea area)	9
9	Glands to genital markings confined to body wall	<i>mertoni</i> (p. 40)
	Glands to genital markings stalked, occupy coelom	<i>sepikensis</i> (p. 40)
10(7)	Bithecal ⁶	<i>brevis</i> (p. 41)
	Polythecal	<i>bifaria</i> (part) (p. 41)
11(7)	Genital markings presetal only (Philippines)	<i>monticola</i> (p. 42)
	Genital markings pre- and postsetal (New Guinea)	<i>bifaria</i> (part) (p. 41)
	Genital markings postsetal only (Japan)	<i>iizukai</i> (p. 43)
12(5)	Spermathecal pores <i>c.</i> 0.3 body circumference apart (genital markings as fig. 20b)	<i>panarana</i> (p. 45)
	Spermathecal pores <i>c.</i> 0.5 body circumference apart (genital markings as fig. 20a)	<i>gatesi</i> (p. 44)
13	First spermathecal pores in furrow 4/5 (five thecal segments)	<i>pentacystis</i> (p. 48)
	First spermathecal pores in furrow 5/6	14
	First spermathecal pores in furrow 6/7	19
	First spermathecal pores in furrow 7/8 (two thecal segments)	<i>renschii</i> (p. 56)
14	One or two thecal segments	15
	Four thecal segments	17
15	Stalked glands discharge into copulatory pouches; external postclitellar genital markings absent	<i>grata</i> (p. 46)
	Copulatory pouches lack stalked glands; external postclitellar genital markings present	16
16	Postclitellar genital markings simple, presetal; spermathecal pores <i>c.</i> 0.25 body circumference apart	<i>elongata</i> species-complex (part) (p. 52)
	Postclitellar genital markings complex, occupying whole length of segment; spermathecal pores <i>c.</i> 0.50 body circumference apart	<i>aringeana</i> (p. 55)
17(14)	Spermathecal batteries with 6–10 spermathecae in each (Malaya and Borneo)	18
	Spermathecal batteries with 1 spermatheca in 5/6/7/8, 8–10 in 8/9 (Sumatra)	<i>lesonea</i> (part) (p. 51)

18	Male pores c. 0·17 body circumference apart (Borneo)	<i>koyana</i> (p. 50)
	Male pores c. 0·24 body circumference apart (Malaya)	<i>polytheca</i> (p. 49)
19(13)	One thecal segment	20
	Three thecal segments	<i>lesonea</i> (part) (p. 51)
20	Spermathecal batteries with 1 spermatheca in each (Vietnam)	<i>annamensis</i> (p. 56)
	Spermathecal batteries with more than 1 spermatheca in each (Indonesia)	<i>elongata</i> species-complex (part) (p. 52)
21(1)	Papuan specimens	22
	Specimens from the Lesser Sunda Islands	23
22	Two thecal segments (<i>vi-vii</i>); spermathecal pores c. 0·33 body circumference apart	<i>huonensis</i> (p. 63)
	Three thecal segments (<i>v-vii</i>); spermathecal pores c. 0·42 body circumference apart	<i>coplandi</i> (p. 62)
	Four thecal segments (<i>v-viii</i>); spermathecal pores c. 0·26 body circumference apart	<i>kershawae</i> (p. 62)
	Five thecal segments (<i>v-ix</i>); spermathecal pores c. 0·55 body circumference apart	<i>patae</i> (p. 61)
23(21)	First spermathecal pores in furrow 4/5	24
	First spermathecal pores in furrow 5/6 ⁷	26

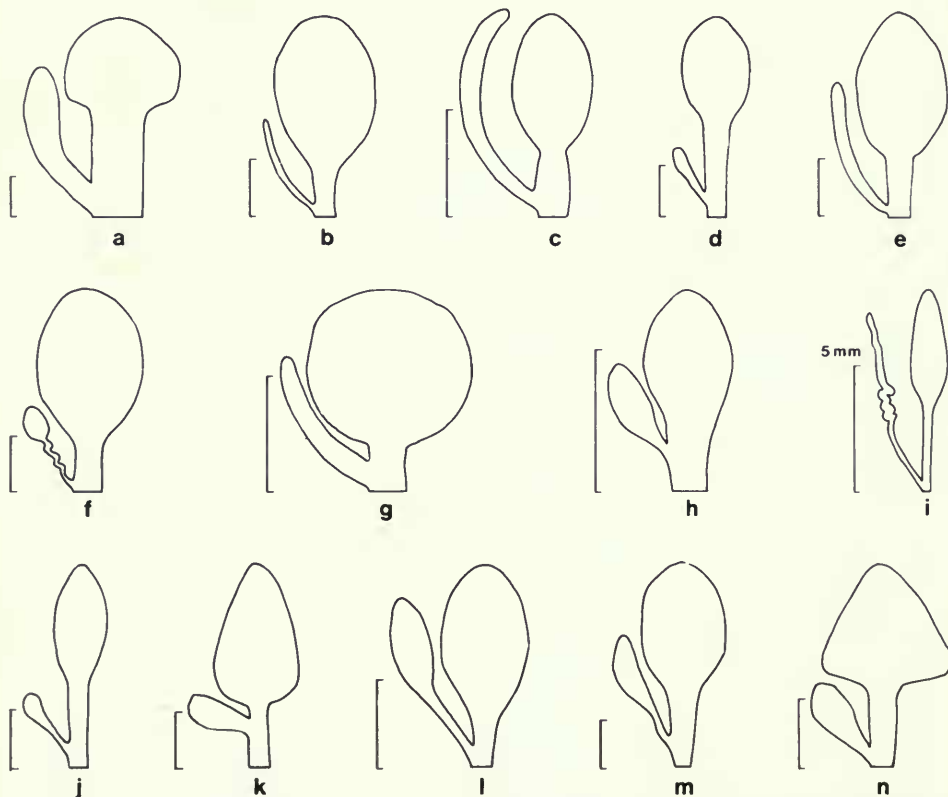


Fig. 14 Spermathecae. (a) *Polypheretima annulata*; (b) *P. fida*; (c) *P. moelleri*; (d) *P. sempolensis* sp. nov.; (e) *P. mertoni*; (f) *P. sepikensis*; (g) *P. brevis*; (h) *P. bifaria*; (i) *P. izzukai*; (j) *P. gatesi* sp. nov.; (k) *P. panarana*; (l) *P. taprobanae*; (m) *P. grata*; (n) *P. veoltzkowi*. All scales 0·5 mm unless otherwise indicated.

24	Bithecal	25
	Polythecal	<i>sibogae</i> ¹ (p. 58)
25	Spermathecal pores c. 0.3 body circumference apart	<i>badia</i> (part) (p. 59)
	Spermathecal pores c. 0.5 body circumference apart	<i>kellneri</i> (p. 57)
26(23)	Three thecal segments	<i>swelaensis</i> (p. 60)
	Four thecal segments	27
27	Spermathecal pores c. 0.3 body circumference apart	<i>badia</i> (part) (p. 59)
	Spermathecal pores c. 0.5 body circumference apart	<i>elberti</i> (p. 60)

¹ It is uncertain whether the unique type of *P. sibogae* is proandric or metandric. This species has therefore been keyed out to allow for either condition.
² *Pheretima cupreae* Chen, 1946 (species incertae sedis) will also emerge at this dichotomy. It may be distinguished from *annulata* by the arrangement of its genital markings (the distribution of this taxon is also different).
³ *Pheretima touranensis* Michaelsen, 1934c (species incertae sedis) will key out at this point. It may be distinguished from *taprobanae* by the possession of two pairs of spermathecal pores (in furrows 7/8/9).
⁴ *Planapheretima subulata* closely resembles some species of *Polypheretima*, especially in the form of the genital markings and male pores, so it has been included here to aid differentiation.
⁵ *Archipheretima picta* will key out at this point. The male pores and genital markings of this species closely resemble those of *Polypheretima*, and confusion may occur when dealing with individuals lacking fully developed clitella and spermathecal diverticula.
⁶ *Pheretima flabellifera* Cognetti, 1911 (species incertae sedis) will key out at this point. It may be distinguished from *brevis* only by the possession of genital markings and small testes sacs.
⁷ Although *Polypheretima badia* is diagnosed as possessing spermathecal pores in furrows 5/6/7/8/9 and occasionally 4/5, there are discrepancies between the type series and the original description. The latter reported individuals with spermathecal pores in furrows 6/7/8/9 only, such individuals will emerge at this dichotomy.

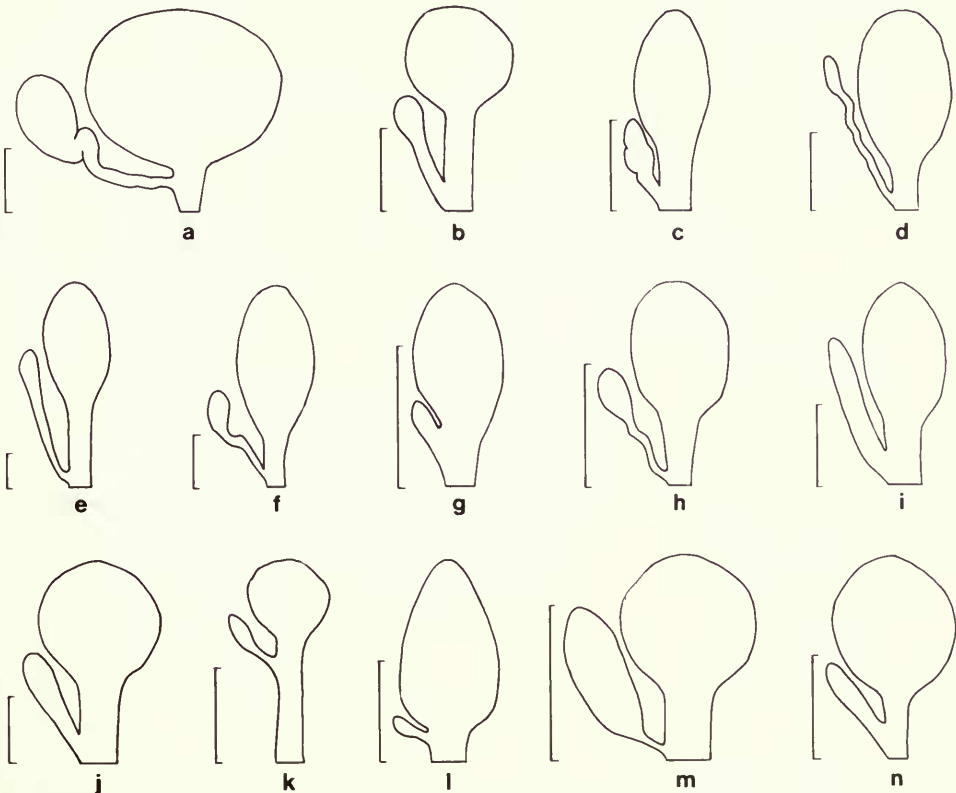


Fig. 15 Spermathecae. (a) *Polypheretima pentacystis*; (b) *P. polytheca*; (c) *P. koyana*; (d) *P. lesonea* sp. nov.; (e) *P. everetti*; (f) *P. aringearna*; (g) *P. annamensis*; (h) *P. sibogae*; (i) *P. elberti*; (j) *P. swelaensis*; (k) *P. patae* sp. nov.; (l) *P. coplandi* sp. nov.; (m) *P. kershawae* sp. nov.; (n) *P. huonensis* sp. nov. All scales 0.5 mm.

Polypheretima annulata species-complex

DIAGNOSIS. *Polypheretima* with simple male pores; paired presetal spermathecal pores on *vii* and *viii* or *vii*, *viii* and *ix*.

DESCRIPTION. *External characters.* Length 58–195 mm, diameter 3–7 mm. 56–146 segments. Clitellum *xiv*–*xvi*. First dorsal pore 10/11–13/14. Setae, 45–72 on *vii*, 50–90 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores on small porophores 0.25–0.28 body circumference apart. Female pore single. Spermathecal pores paired, presetal on *vii* and *viii* or *vii*, *viii* and *ix*, 0.45–0.50 body circumference apart.

Genital markings (Fig. 17a), small, paired, postsetal on *vii*, *viii*, *ix*, two pairs of presetal and two pairs of postsetal markings on *xvii*–*xix*, lateral pairs slightly median to the line of the male pores. *Internal characters.* Septa 5/6/7/8 thickened, 8/9 membranous or slightly thickened, 9/10–12/13 thickened. Intestine begins in *xv*. Lateral hearts in *x*–*xiii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles small in *xi* and *xii*, pseudoseminal vesicles in *xiii*, large. Spermathecae (Fig. 14a) paired in *vii*–*viii* or *vii*–*ix*.

DISTRIBUTION. (Fig. 16.) West and southwest New Guinea and the islands to the southwest.

REMARKS. The *P. annulata* species-complex is readily recognized by the segmental position of the spermathecal pores. Only one other species of this genus, *voeltzkowi*, has segmental spermathecal pores but they are postsetal on *v*.

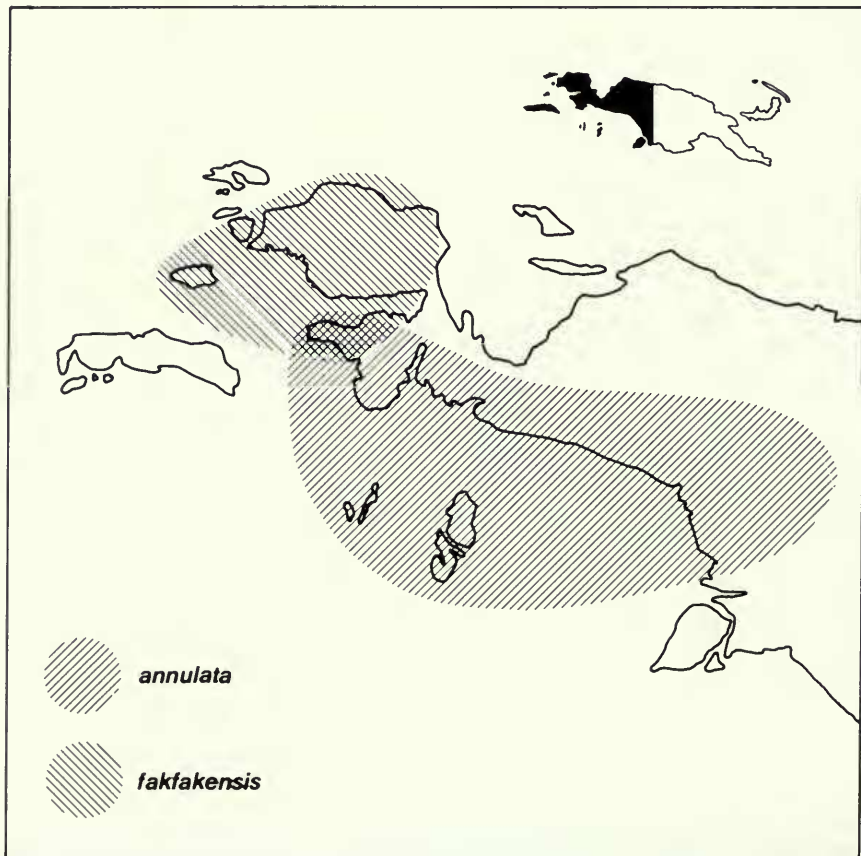


Fig. 16 *Polypheretima annulata* species complex: geographical distribution of the component species.

The two species included are separable on the number of pairs of spermathecae:

P. annulata, characterized by the presence of spermathecae opening onto *vii* and *viii*, occurs in the south-eastern part of the range of the species-complex while *P. fakfakensis* with spermathecae opening onto *vii*, *viii* and *ix*, occurs in the northwestern portion of the range.

The close affinity of these two species was first recognized by Michaelsen (1910a) when he described *fakfakensis tetratheca*, which is here included in the synonymy of *annulata* together with *kochii* and its synonyms *invisa* and *schaedleri* (Michaelsen, 1938).

***Polypheretima annulata* (Horst, 1883)**

Megascolex annulatus Horst, 1883 : 195.

Perichaeta annulata: Horst, 1890 : 236; Horst, 1893 : 29; Beddard, 1895 : 426.

Amyntas annulatus: Beddard, 1900a : 634.

Pheretima annulata: Michaelsen, 1900 : 253.

Metapheretima annulata: Sims & Easton, 1972 : 233.

Pheretima fakfakensis tetratheca Michaelsen, 1910a : 254; Michaelsen, 1922 : 53; Michaelsen, 1930b : 13; Gates, 1936b : 385.

Metapheretima fakfakensis tetratheca: Sims & Easton, 1972 : 233.

Pheretima kochii Cognetti, 1913 : 293.

Pheretima (Pheretima) kochii: (syn. *invisa*, *schaedleri*) Michaelsen, 1938 : 167.

Metapheretima kochii: Sims & Easton, 1972 : 233.

Pheretima invisae Cognetti, 1913 : 294.

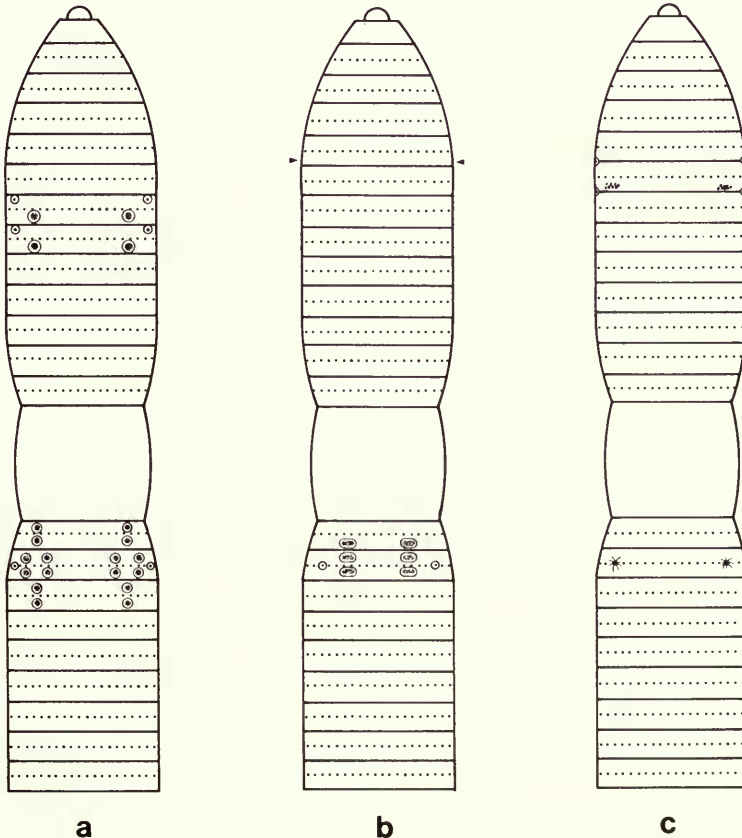


Fig. 17 Anterior ventral surface, diagnostic characters. (a) *Polypheretima annulata*; (b) *P. voeltzkowi*, arrows indicate dorsal postsetal spermathecal pores; (c) *P. grata*.

*Metapheretima invis*a: Sims & Easton, 1972 : 233.

Pheretima schaedleri Michaelsen, 1922 : 52.

Metapheretima schaedleri: Sims & Easton, 1972 : 233.

DIAGNOSIS. *P. annulata* species-complex with spermathecal pores on segments *vii* and *viii*.

DISTRIBUTION. Southwest New Guinea, Kepulauan Banda, Kepulauan Kai, Kepulauan Aru.

MATERIAL EXAMINED. 2C 'Indonesia'; Leiden 1855 (syntypes of *annulata*). 4C Gt Kai, Kepulauan Kai; Hamburg v3032 (syntypes of *fakfakensis tetratheca*). 1C Gt Kai, Kepulauan Kai; Bogor Ann058 (*fakfakensis tetratheca*: Gates, 1936). 2C, 1A Etna Bay, West Irian; Amsterdam Vol. 275 (syntypes of *kochii*). 1C Bivak Island, West Irian; Hamburg v11729 (*kochii*: Michaelsen, 1938, other specimens of this series, Amsterdam Vol. 278, were not examined). 1C Sabang, West Irian; Amsterdam Vol. 270 (syntype of *invisa*). 1C Skroë, West Irian; Leiden 1822 (holotype of *schraedleri*).

OTHER RECORDS. Wammer Island, Kepulauan Aru (syntype(s) of *fakfakensis tetratheca*). Kobroor Island, Kepulauan Aru (syntype(s) of *fakfakensis tetratheca*). Dobo, Kepulauan Aru; Leiden 1815 (*fakfakensis tetratheca*: Michaelsen, 1922). Kepulauan Aru (*fakfakensis tetratheca*: Michaelsen 1930). Near river Lorentz, West Irian (syntype of *kochii*). Bivak Island and north of river Lorentz, West Irian (syntypes of *invisa*).

Polypheretima fakfakensis (Cognetti, 1908)

Pheretima fakfakensis Cognetti, 1908 : 1.

Pheretima (*Pheretima*) *fakfakensis*: Michaelsen, 1930*b* : 12.

Metapheretima fakfakensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *P. annulata* species-complex with spermathecal pores on segments *vii*, *viii* and *ix*.

DISTRIBUTION. Western New Guinea; Misoöl Island.

REMARKS. Preclitellar genital markings are present on *viii* and *ix* (*vii* and *viii* in *P. annulata*) in the specimens examined.

MATERIAL EXAMINED. *Previously reported*. 2C Fakfak, West Irian; BMNH 1908.5.12.1-2 (syntypes of *fakfakensis*). 1C Misoöl Islands, West Irian; Hamburg v11638 (*fakfakensis*: Michaelsen, 1930, reported from a long series but the present location of the other individuals in unknown). *New record*. 2C, 1A Vogelkop, West Irian; Leiden.

Polypheretima bifaria species-group

DIAGNOSIS. *Polypheretima* with simple male pores; intersegmental spermathecal pores. Holandric.

DISTRIBUTION. Indigenous species occur throughout the *Pheretima* domain. Three species, *brevis*, *fida* and *taprobanae*, are known only from localities to which they are suspected of being introduced.

SPECIES INCLUDED. *bifaria*, *brevis*, *fida*, *gatesi*, *iizukai*, *mertoni*, *moelleri*, *monticola*, *panarana*, *sempolensis*, *sepikensis*, *taprobanae*.

REMARKS. Several morphological trends may be detected among the species assigned to this group. The Asian representatives have only a single pair of genital markings on each of several segments while those from the Papuan region have more numerous genital markings restricted to one or two segments near the male pores (see also *annulata* species-complex and the *patae* species-group). The glands associated with the genital markings in all Asian and most Papuan species are restricted to the body wall but those of species from the north eastern part of New Guinea are stalked and conspicuous (see also the Papuan species *grata*). This species-group is proposed for convenience of identification.

Marker characters of the species included in the *bifaria* species-group are given in Table 6.

Table 6 Marker characters of the members of the *Polypheretima bifaria* species-group

Species	Spermathecal furrows	Separation of spermathecal pores	Postclitellar genital markings	Indigenous distribution
<i>fida</i>	4/5/6 or 4/5/6/7	0.50	1 pair pre- and postsetal <i>xvii</i> , <i>xix</i> (Fig. 18a)	? Loyalty Is.
<i>moelleri</i>	4/5/6/7/8/9	?	?	Java
<i>sempolensis</i>	5/6/7	0.33	1 pair <i>xvii</i> , <i>xix</i> (Fig. 18b)	Java
<i>mertoni</i>	5/6/7	0.40	1 pair pre- and postsetal and single median presetal <i>xvii-xix</i> (Fig. 18c)	Aru Islands
<i>sepikensis</i>	5/6/7	0.33	numerous, random on <i>xviii</i> stalked glands present (Fig. 18d)	North east New Guinea
<i>brevis</i>	5/6/7/8	0.53	?	? Christmas Island (Indian Ocean)
<i>bifaria</i>	5/6/7/8 or 5/6/7/8/9	0.33 (polythecal)	2 pairs pre- and postsetal <i>xviii</i> , 1 pair <i>xvii</i> , <i>xix</i> (Fig. 19a)	North west New Guinea
<i>monticola</i>	5/6/7/8/9	?	1 pair presetal, <i>xvii</i> , <i>xix-xx</i> (Fig. 19b)	Philippines
<i>iizukai</i>	5/6/7/8/9	?	1 pair postsetal <i>xix-xxiii</i> (Fig. 19c)	Japan
<i>gatesi</i>	6/7	0.51	numerous, random on <i>xviii</i> (Fig. 20a)	East New Guinea
<i>panarana</i>	6/7	0.30	numerous in clusters round ♂ pores stalked glands present (Fig. 20b)	West New Guinea
<i>taprobanae</i>	7/8	0.50	1 pair presetal <i>xix-xxii</i> (Fig. 20c)	?

Polypheretima fida (Michaelsen, 1913)

Pheretima fida Michaelsen, 1913b : 259.

Metapheretima fida: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; spermathecal pores in furrows 4/5/6 and occasionally 6/7. Holandric.

DESCRIPTION. *External characters.* Length 40–60 mm, diameter 4–5 mm. 93–98 segments. Clitellum *xiv*– $\frac{1}{2}$ *xvi*. First dorsal pore 10/11. Setae, 40–50 on *vii* and *xx*, setal ring regular with ventral gaps ($aa = 1.5ab = 1.5yz = 1.5zz$).

Male pores on circular porophores, occasionally slightly invaginated, *c.* 0.30 body circumference apart. Female pores paired. Spermathecal pores paired, intersegmental in 4/5/6 and occasionally 6/7, *c.* 0.50 body circumference apart.

Genital markings (Fig. 18a) simple, paired, presetal on *xi-xiii* slightly median to the line of the spermathecal pores, pre and postsetal on *xvii* and *xix* in line with the male pores.

Internal characters. Septa 4/5–6/7 thickened, 7/8–8/9 absent, 9/10–11/12 thickened. Intestine begins in *xv*. Lateral hearts in *x-xii*.

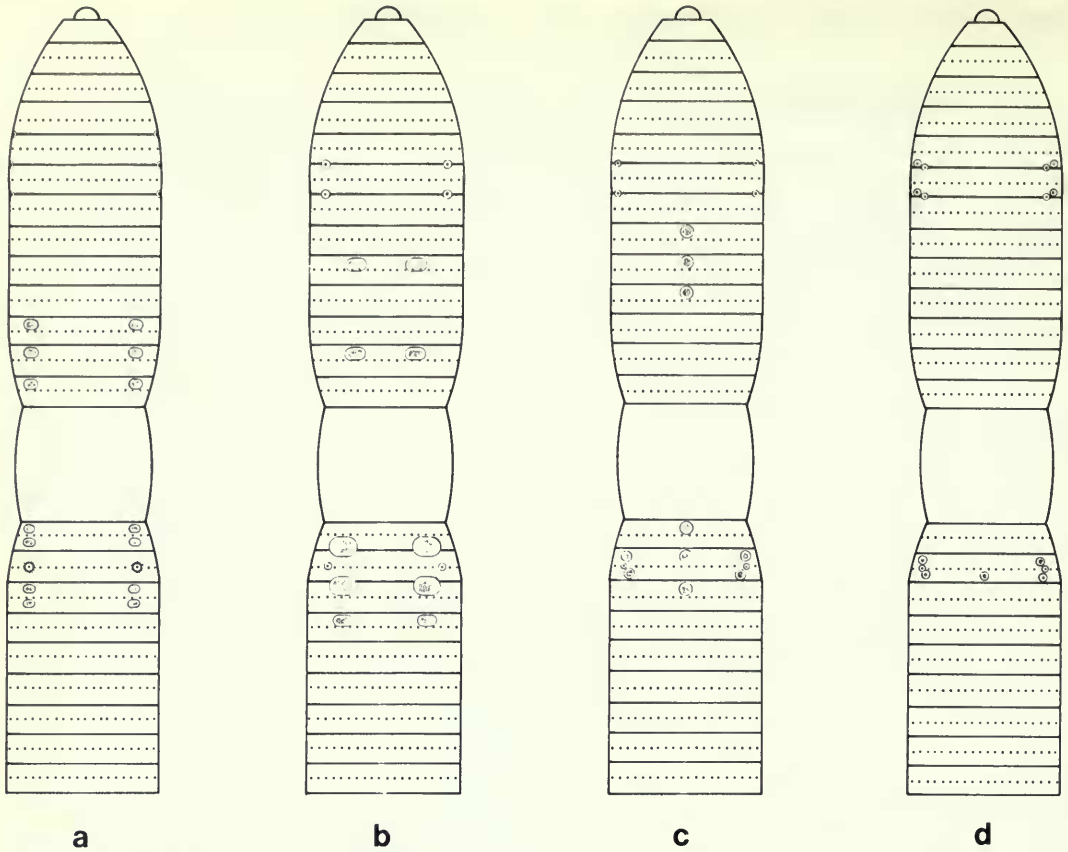


Fig. 18 Anterior ventral surface, diagnostic characters. (a) *Polypheretima fida*; (b) *P. sempolensis* sp. nov.; (c) *P. mertoni*; (d) *P. sepikensis*.

Holandric, testes sacs annular in x and xi , enclosing the lateral hearts and in xi the seminal vesicles, seminal vesicles large, reaching the dorsal line in xi and xii . Pseudoseminal vesicles absent. Spermathecae (Fig. 14b) paired in v , vi , and occasionally in vii .

DISTRIBUTION. Loyalty Islands.

REMARKS. The only record of *fida* is based on the type series collected in the Loyalty Islands which are only tentatively included within the *Pheretima* domain (see above). As the five other representatives which have been recorded from the Loyalty Islands and nearby New Caledonia (*Amyntas diffringens*, *A. rodericensis*, *A. taitensis*, *Pheretima montana* and *Polypheretima elongata*) are all peregrine species (Michaelsen, 1913b) the occurrence of *fida* in this area is also probably the result of introduction by man. Possible evidence for *fida* being indigenous in this area is its low affinities (see numerical studies) with other species of the *bifaria* species-group.

MATERIAL EXAMINED. 5C Lifu, Loyalty Islands; Hamburg v8067 (syntypes of *fida*). 4C Uvea, Loyalty Islands; Hamburg v8068 (syntypes of *fida*).

Polypheretima moelleri (Michaelsen, 1921)

Pheretima mölleri Michaelsen, 1921 : 12.

Metapheretima moelleri: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores in furrows 4/5/6/7/8/9. Holandric.

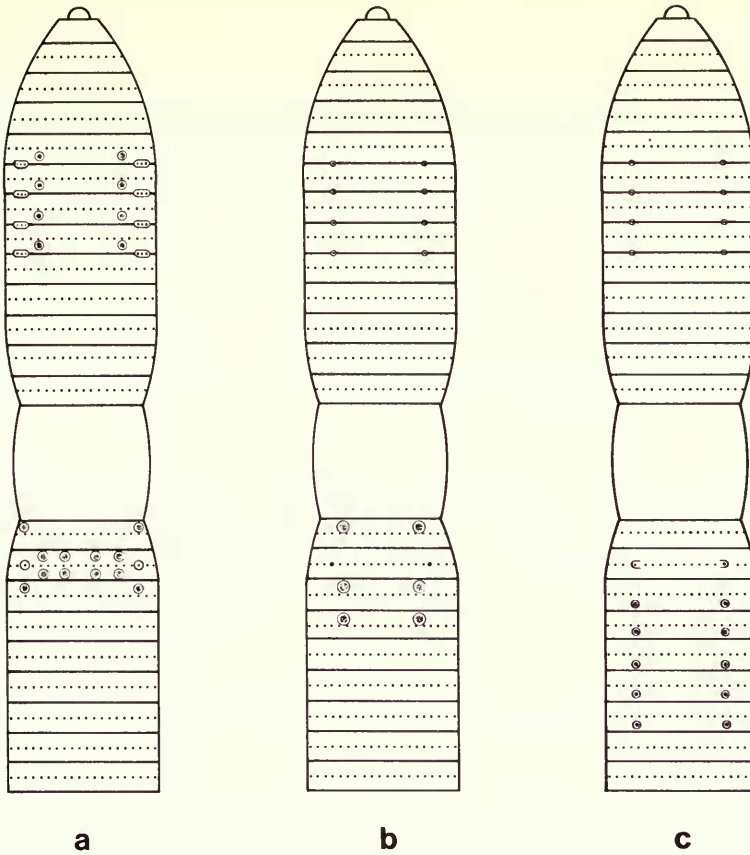


Fig. 19 Anterior ventral surface, diagnostic characters. (a) *Polypheretima bifaria*; (b) *P. monticola*; (c) *P. iizukai*.

DESCRIPTION. *External characters.* Length over 24 mm, diameter *c.* 1.3 mm. Over 41 segments. (The unique holotype lacks a posterior portion.) Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, *c.* 24 on *ii*, *c.* 30 on *iii*, *c.* 40 on *viii*, *c.* 36 on *xxvi*, setal ring with ventral gaps ($aa=1-1.3ab$).

Male pores simple, on large hemispherical porophores, *c.* 0.40 body circumference apart. Female pore(s) not recorded. Spermathecal pores paired, intersegmental in 4/5/6/7/8/9, separation not recorded.

Genital markings absent.

Internal characters. Anterior septa delicate, 7/8 absent. Beginning of intestine not recorded. Lateral hearts not recorded.

Holandric, testes sacs large, paired in *x* and *xi*, seminal vesicles in *xi* and *xii*. Spermathecae (Fig. 14c) paired in *v-ix*.

Description after Michaelsen (1921).

DISTRIBUTION. Java.

REMARKS. It has not been possible to locate any examples of this species and *moelleri* is only tentatively assigned to *Polypheretima* in the absence of any of the characteristics diagnostic of other acaecate genera (none of which has been recorded from Java).

RECORDS. 1C (incomplete) Sand Bay, south coast of Java (holotype of *moelleri*).

Polypheretima sempolensis sp. nov.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores in furrows 5/6/7. Holandric. Postclitellar genital markings simple, postsetal on *xvii*, presetal on *xix*.

DESCRIPTION. *External characters.* Length 50–62 mm, diameter *c.* 2 mm. 100–107 segments. Clitellum *xiv–xvi*. First dorsal pore 13/14. Setae, *c.* 60–66 on *vii*, 44–48 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple on porophores, *c.* 0.33 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 5/6/7, *c.* 0.33 body circumference apart.

Genital markings (Fig. 18b) simple paired, presetal on *ix*, *xii* and occasionally *xiii*, median to the line of the spermathecal pores, postsetal on *xvii*, presetal on *xix* and occasionally *xx*, median to the line of the male pores. The genital markings are exceptionally large, invading the setal lines and the intersegmental furrows.

Internal characters. Septa 5/6–7/8 thickened, 8/9/10 membranous, 10/11–12/13 thickened. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Holandric, testes sacs on *x* separated ventrally but linked dorsally, that of *xi* annular and enclosing the anterior seminal vesicles, seminal vesicles slim, elongate, reaching the dorsal line in *xi* and *xii*, pseudoseminal vesicles small in *xiv*. Spermathecae (Fig. 14d) paired in *vi* and *vii*.

DISTRIBUTION. East Java, 1400–1500 m.

MATERIAL EXAMINED. 3C Primary forest with rich black soil tending to be rather dry, on top of ridge of ancient crater wall, Sempol Crater, East Java, 8° 03' S, 114° 12' E, 1500 m, coll G A Lincoln 29 Jul 1973 British University Dragon Expedition; BMNH 1975.7.48–50 (syntypes of *sempolensis*). 11C, 7A Loose black soil in middle of coffee plantation, plateau of Gunung Raung, Sempol, East Java, 1400 m, coll G A Lincoln 27 Jul 1973 British University Dragon Expedition; BMNH 1975.7.28–47.

Polypheretima mertoni (Michaelsen, 1910)

Pheretima mertoni Michaelsen, 1910a : 256.

Metapheretima mertoni: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores about two fifths of the body circumference apart in furrows 5/6/7. Holandric. Postclitellar genital markings single presetal median and paired, pre- and postsetal close to the line of the male pores.

DESCRIPTION. *External characters.* Length 36–58 mm, diameter 2–2.5 mm. 76–82 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13 or 13/14. Setae, *c.* 44 on *vii*, *c.* 40 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple *c.* 0.30 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 5/6/7, *c.* 0.40 body circumference apart.

Genital markings (Fig. 18c), single median, presetal on *viii*, *ix*, *xvii–xix*, paired, pre- and postsetal, close to the line of the male pores on *xviii*.

Internal characters. Septa 5/6/7 slightly thickened, 7/8–13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Holandric, testes sacs paired with narrow ventral connections, large, extending to the dorsal line in *x* and *xi*, seminal vesicles large, extending to the dorsal line in *xi* and *xii*, those of *xi* enclosed in the testes sacs. Spermathecae (Fig. 14e) paired in *vi* and *vii*.

DISTRIBUTION. Kepulauan Aru.

MATERIAL EXAMINED. 3C Wokam, Aru Kepulauan; Hamburg v3035 (syntypes of *mertoni*).

Polypheretima sepikensis (Ude, 1924)

Pheretima sepikensis Ude, 1924 : 81.

Pheretima (Pheretima) sepikensis: Ude, 1932 : 135.

Metapheretima sepikensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores about one third of body circumference apart in furrows 5/6/7. Holandric. Postclitellar genital markings simple, randomly arranged on *xviii*, with stalked glands discharging into them.

DESCRIPTION. *External characters.* Length 40–60 mm, diameter 2–3 mm. 100–120 segments. Clitellum *xiv–xvi*. First dorsal pore 5/6. Setae, 48–50 on *vii*, 44–48 on *xx*, setal ring regular ($aa=ab=yz=zz$).

Male pores on small circular porophores *c.* 0.33 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 5/6/7, *c.* 0.33 body circumference apart.

Genital markings (Fig. 18d) small, paired, postsetal on *v* and *vi*, slightly lateral to the spermathecal pores, small, numerous, randomly arranged on *xviii*.

Internal characters. Septa 5/6–13/14 slightly thickened. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Holandric, testes sacs large, paired, extending to the dorsal line in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*, those of *xi* enclosed in the testes sacs. Spermathecae (Fig. 14f) paired in *vi* and *vii*.

Stalked glands discharge through the genital markings associated with the male pores and spermathecal pores.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 9C, 4A Sepik area, Papua New Guinea; Berlin 6471 (syntypes of *sepikensis*).

Polypheretima brevis (Rosa, 1898)

Perichaeta brevis Rosa, 1898a : 288.

Amyntas brevis: Beddard, 1900a : 636.

Pheretima brevis: Michaelsen, 1900 : 257.

Metapheretima brevis: Sims & Easton, 1972 : 180, 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores about half body circumference apart in furrows 5/6/7/8. Holandric.

DESCRIPTION. *External characters.* Length 15–20 mm, diameter 1.5–2.5 mm. 70–80 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13 or 13/14. Setae, 48–52 on *vii*, 40–50 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), with ventral gaps on postclitellar segments ($aa=1.5ab=1.5yz=1.5zz$).

Male pores simple, on small circular porophore *c.* 0.28 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 5/6/7/8, *c.* 0.53 body circumference apart.

Genital markings absent.

Internal characters. Septa 5/6–13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Holandric, testes sacs paired, those of *x* large, extending to the dorsal line, those of *xi* small, ventral, seminal vesicles in *xi* and *xii*, extending to the dorsal line. Pseudoseminal vesicles in *xiii*. Spermathecae (Fig. 14g) paired in *vi–viii*.

DISTRIBUTION. Christmas Island, Indian Ocean.

REMARKS. *P. brevis* is known only from Christmas Island in the Indian Ocean. The oceanic nature of this island suggests that the record of *brevis* is the result of introduction through the agency of man. The affinities of *brevis* with the Papuan representatives of the *bifaria* species-group (see numerical studies) may indicate that it is indigenous in the New Guinea area.

None of the three syntypes possess genital markings, but when more material becomes available it is possible that markings will be found similar to those of *bifaria*.

MATERIAL EXAMINED. 3C Christmas Island, Indian Ocean; BMNH 1898.10.28.1–2 (syntypes of *brevis*).

Polypheretima bifaria (Michaelsen, 1924)

Pheretima bifaria Michaelsen, 1924 : 18.

Pheretima (Polypheretima) bifaria: Michaelsen, 1934b : 16.

Pheretima (Polypheretima) bifaria typica: Michaelsen, 1938 : 171.

Metapheretima bifaria bifaria: Sims & Easton, 1972 : 233.

Pheretima (Polypheretima) bifaria wirzi Michaelsen, 1938 : 171.

Metapheretima bifaria wirzi: Sims & Easton, 1972 : 233.

? *Pheretima polytheca aruensis* Michaelsen, 1910a : 252.

? *Pheretima (Polypheretima) polytheca aruensis*: Michaelsen, 1934b : 16.

? *Metapheretima polytheca aruensis*: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; numerous spermathecal pores in paired batteries in furrows 5/6/7/8 and usually 8/9. Holandric. Postclitellar genital markings, two pairs of presetal and two pairs of postsetal markings on each segment.

DESCRIPTION. *External characters*. Length 27–49 mm, diameter 1.5–2.5 mm. 99–110 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12 or 12/13. Setae, 33–45 on *vii*, 32–40 on *xx*, setal ring regular with dorsal and ventral gaps ($aa = 1.5 - 2ab = 2yz = zz$).

Male pores simple on large porophores 0.30–0.33 body circumference apart. Female pore single. Spermathecal pores numerous in paired intersegmental batteries of 1–3 pores in 5/6/7/8 and usually 8/9, *c.* 0.30 body circumference apart.

Genital markings (Fig. 19a), simple, single median or closely paired pre- or postsetal on *v–ix*, paired, presetal in line with the male pores, on *xvii* and *xix*, two pairs of presetal and two pairs of postsetal, on *xviii* median to the male pores.

Internal characters. Septa 5/6–7/8 thickened, 8/9 membranous, 9/10–12/13 thickened. Intestine begins in *xv*. Lateral hearts in *x–xiii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*, those of *xi* are enclosed in testes sacs. Spermathecae (Fig. 14h) numerous in paired batteries of 1–3 spermathecae in *vi*, *vii*, *viii* and usually *ix*.

DISTRIBUTION. New Guinea and possibly Kepulauan Aru.

REMARKS. Michaelsen (1938) recognized two subspecies of *bifaria*, one with single and the other with paired preclitellar genital markings. It is considered that these differences indicate individual variation and that they do not provide the means of recognizing subspecies.

The type series of *polytheca aruensis* could not be located during the preparation of this paper, but from the original description it appears to be closely allied to *bifaria* and differs considerably from the nominate subspecies of *polytheca* (known only from Malaya).

MATERIAL EXAMINED. 3C Doormanpad-biwak, West Irian; Hamburg v9400 (syntypes of *bifaria bifaria*). 2C Panarana-del, West Irian; Amsterdam Vol. 247 (*bifaria typica*: Michaelsen, 1938). 1C Panarana-del, West Irian; Amsterdam Vol. 246 (holotype of *bifaria wirzi*).

OTHER RECORDS. ?–, Kobroor, Aru Kepulauan (type(s) of *polytheca aruensis*).

Polypheretima monticola (Beddard, 1912)

Pheretima monticola Beddard, 1912: 195.

Metapheretima monticola: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores in furrows 5/6/7/8/9. Holandric. Postclitellar genital markings simple, paired, presetal.

DESCRIPTION. *External characters*. Length *c.* 130 mm, diameter *c.* 7 mm. Segment number not recorded. Clitellum *xiv–xvi*. Position of first dorsal pore not recorded. Setal numbers not recorded.

Male pores 'conspicuous', widely separated. Condition of female pore(s) not recorded. Spermathecal pores paired in 5/6/7/8/9, separation not recorded.

Genital markings (Fig. 19b) large, circular or oval, presetal, paired markings on *ix*, *xvii*, *xix–xx*, slightly median to the line of the male pores.

Internal characters. All anterior septa present, 9/10–12/13 thickened. Intestine begins in *xv*. Segments with lateral hearts not recorded.

Holandric, testes in *x* and *xi*, either free or in large delicate sacs, seminal vesicles in *xi* and *xii*. Spermatheca paired in *vi–ix*, duct short, ampulla spherical, diverticulum long and convoluted, terminating in a small spherical ampulla.

Description after Beddard, 1912; Fig. 19b is an interpretation of the genital field based on the written description.

DISTRIBUTION. Luzon, Philippines.

REMARKS. Beddard's original description lacked detailed information and since the type series cannot be located, this species is tentatively assigned to the genus *Polypheretima* where it is placed provisionally in the *bifaria* species-group. (The clitellum extends over only three segments and the spermathecal diverticula are apparently simple.)

At present *monticola* is unique in being the only indigenous species of *Polypheretima* from the Philippines.

RECORDS. 2 specimens, Mt Pulong, Luzon, Philippines (syntypes of *monticola*).

Polypheretima iizukai (Goto & Hatai, 1899)

Perichaeta iizukai Goto & Hatai, 1899 : 14.

Amyntas iizukai: Beddard, 1900a : 625.

Pheretima iizukai: Michaelsen, 1900 : 274; Ohfuchi, 1937 : 39; Kobayashi, 1941a : 260, 266; Kobayashi, 1941b : 380, 381.

Metapheretima iizukai: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores in furrows 5/6/7/8/9. Holandric. Postclitellar genital markings paired, postsetal.

DESCRIPTION. *External characters*. Length *c.* 235 mm, diameter 12–15 mm. *C.* 137 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, *c.* 34 on *iv*, *c.* 40 on *v*, *c.* 42 on *vi*, *c.* 50 on *viii*, *c.* 60 on posterior segments. Setal ring regular.

Male pores simple, *c.* 8 setae apart. Female pore(s) not recorded. Spermathecal pores paired, intersegmental in 5/6/7/8/9, separation not recorded.

Genital markings (Fig. 19c) paired, postsetal, in line with the male pores on *xix–xxiii*.

Internal characters. Septa 4/5–7/8 thickened, 8/9/10 absent, 10/11–12/13 thickened. Intestine begins in *xv*. Last lateral hearts in *xiii*.

Holandric, testes sacs in *x* and *xi*, seminal vesicles in *xi* and *xii*, no other details recorded. Spermathecae (Fig. 14i) paired in *vi–ix*.

Description after Goto & Hatai (1899).

DISTRIBUTION. Japan.

REMARKS. *P. iizukai* is the only representative of *Polypheretima* recorded from Japan where it occurs at the northernmost limit of the genus. Two other Japanese species, *Amyntas fuscatus* (Goto & Hatai, 1898) and *Metaphire grossa* (Goto & Hatai, 1898), have postsetal genital markings and spermathecal pores in furrows 5/6/7/8/9 and may be confused with *iizukai*. However, they are readily distinguishable by the presence of intestinal caeca.

Although the earthworm fauna of Japan has received considerable attention prior to 1940, this species has been recorded only four times. Of these recorded, one (Ohfuchi, 1937) is suspect since Ohfuchi noted (p. 41) 'intestinal caeca present' although earlier (p. 39) he had accurately repeated the original description. Kobayashi (1941a & b) recorded this species from only two mountainous districts of central Honshu. The absence of other acaecate species from Japan and from the adjacent Asian mainland may indicate that *iizukai*, by now being confined to mountainous refuges, is a relict from a time when *Polypheretima* was more widespread in Asia.

RECORDS. 1C Musashi, Japan (holotype of *iizukai*, at one time contained in the collections of the University of Tokyo but it could not be located during the preparation of this paper: Dr M. Imajima, private communication). Near Tokyo, Japan (? *iizukai*: Ohfuchi, 1937). Chubu & Kanto districts, Japan (*iizukai*: Kobayashi, 1941a & b, it is uncertain whether these are new records since both papers are in Japanese).

Polypheretima gatesi sp. nov.

? *Pheretima panarana*: Gates, 1948 : 159 (non Michaelsen, 1938 : 167).

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores about half body circumference apart in furrow 6/7. Holandric. Postclitellar genital markings numerous in irregular presetal and postsetal rows.

DESCRIPTION. *External characters*. Length 49–54 mm – the two syntypes of this species are both acilitellate, mature specimens may be considerably larger – diameter *c.* 2 mm. 63–71 segments. Clitellum not recognizable. First dorsal pore 12/13. Setae, 20–24 on *vii*, 36–40 on *xx*, setal ring regular with dorsal and ventral gaps ($aa = 2ab = 2yz = zz$).

Male pores simple on circular porophores *c.* 0.35 body circumference apart. Female pore(s) not detected. Spermathecal pores paired, intersegmental in 6/7, *c.* 0.51 body circumference apart.

Genital markings (Fig. 20a) numerous, irregularly arranged, pre and postsetal on *xviii*, presetal on *xix*.

Internal characters. Septa 5/6–13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x–xiii*.

Holandric, testes sacs paired, those of *x* extending to the dorsal line, those of *xi* small, ventral, seminal vesicles large, extending to the dorsal line in *xi* and *xii*. Pseudoseminal vesicles in *xiii*. Spermathecae (Fig. 14j) paired in *vii*.

DISTRIBUTION. New Guinea.

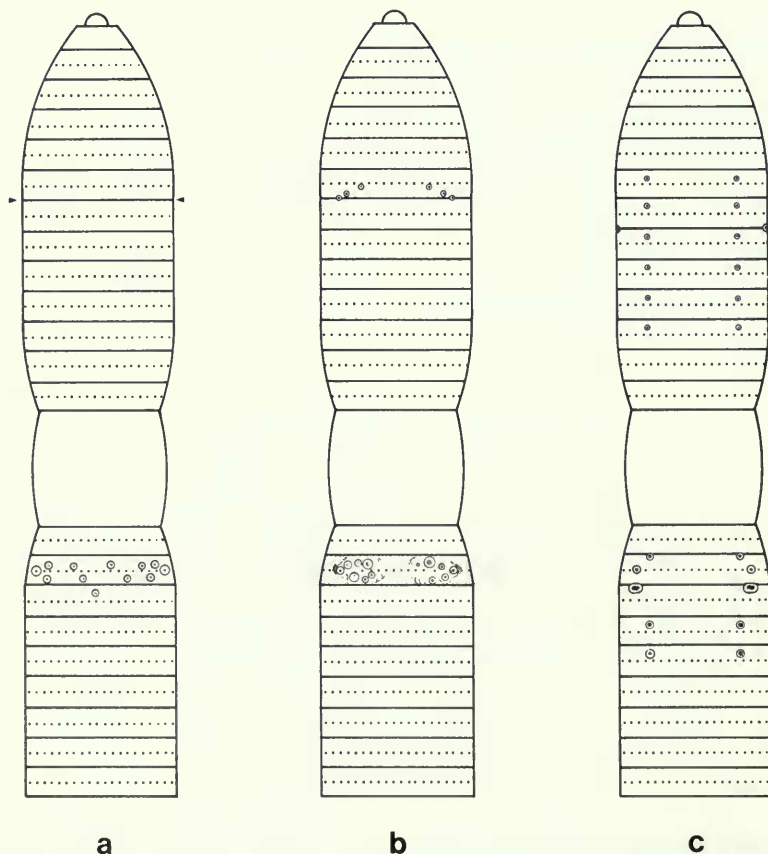


Fig. 20 Anterior ventral surface, diagnostic characters. (a) *Polypheretima gatesi* sp. nov., arrows indicate furrows with dorsal spermathecal pores; (b) *P. panarana*; (c) *P. taprobanae*.

REMARKS. The specimen identified as *panarana* by Gates (1948) has been tentatively assigned to this taxon principally because of the greater separation described between the spermathecal pores than is found in *panarana* sensu stricto.

MATERIAL EXAMINED. 2A Local government piggery, Wabag, Mt Hagen, District, Western Highlands, Papua New Guinea, 5° 28' S, 143° 40' E, coll J W Copland; BMNH 1976.3.184-185 (syntypes of *gatesi*).

OTHER RECORDS. ? 1C Mt Wilhelmina, West Irian (*panarana*: Gates, 1948).

Polypheretima panarana (Michaelsen, 1938)

Pheretima (*Pheretima*) *panarana* Michaelsen, 1938 : 167.

[non *Pheretima panarana*: Gates, 1948 : 159 (? = *P. gatesi*)]

Metapheretima panarana: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores about one third body circumference apart in furrow 6/7. Holandric. Postclitellar genital markings in paired clusters associated with the male pores.

DESCRIPTION. *External characters*. Length *c.* 31 mm, diameter *c.* 2.5 mm. *c.* 69 segments. Clitellum *xiv-xvi*. First dorsal pore 13/14. Setae, *c.* 43 on *vii*, *c.* 50 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple on conical porophores *c.* 0.30 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 6/7, *c.* 0.30 body circumference apart.

Genital markings (Fig. 20b), medium sized simple papillae arranged in paired clusters of 2-3 papillae, postsetal on *vii* and presetal on *viii*, median to the spermathecal pores, clusters of up to 5 papillae incorporating the male pores on *xviii*.

Internal characters. Septa 5/6-7/8 membranous, 8/9 absent, 9/10-13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Holandric, testes sacs large, paired, those of *x* extending to the lateral line and those of *xi* extending to the dorsolateral line, seminal vesicles in *xi* and *xii*, those of *xi* enclosed in the testes sacs, those of *xii* extending to the dorsolateral line. Spermathecae (Fig. 14k) paired in *vii*.

Large glandular masses in *vi* and *vii* adjacent to the genital markings, similar masses in *xviii* around the ectal end of the prostatic duct.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 1C Panarana-del, West Irian; Amsterdam Vol. 292 (holotype of *panarana*).

Polypheretima taprobanae (Beddard, 1892)

Perichaeta taprobanae Beddard, 1892 : 163; Beddard, 1895 : 411; Michaelsen, 1897 : 140.

Amyntas taprobanae: (= *pauli*) Beddard, 1900a : 648.

Pheretima taprobanae typica: Michaelsen, 1900 : 308.

Pheretima taprobanae: Michaelsen, 1903a : 12; Michaelsen, 1907 : 46; Stephenson, 1923 : 312; Michaelsen, 1927 : 371; Aiyer, 1929 : 15, 72; Gates, 1937a : 371; Gates, 1937b : 209; Gates, 1945 : 87; Gates, 1972a : 220.

Metapheretima taprobaena: Sims & Easton, 1972 : 181, 233.

Perichaeta pauli Michaelsen, 1897 : 243.

Pheretima taprobanae pauli: Michaelsen, 1900 : 309; Moreira, 1903 : 132.

Metapheretima pauli: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores in furrow 7/8. Holandric.

DESCRIPTION. *External characters*. Length 80-145 mm, diameter 4-7 mm. 95-136 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, 70-80 on *vii*, 60-80 on *xx*, setal ring regular with ventral gaps on preclitellar segments ($aa = 1.5ab = 1.5yz - 1.5zz$) and with dorsal and ventral gaps on postclitellar segments ($aa = 2ab = 2yz = 0.7zz$).

Male pores simple on small porophores *c.* 0.29 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 7/8, *c.* 0.50 body circumference apart.

Genital markings (Fig. 20c), small, simple, paired, presetal on *vi-ix*, slightly median to the spermathecal pores, presetal on *xviii-xxii*, slightly median to the line of the male pores.

Internal characters. Septa 5/6-7/8 thickened, 8/9 membranous, 9/10 absent, 10/11/12 membranous, 12/13/14 thickened. Intestine begins in *xv*. Lateral hearts *x-xii*.

Holandric, testes sacs annular in *x* and *xi*, enclosing the lateral hearts and, in *xi* the seminal vesicles, seminal vesicles in *xi* and *xii*, extending to the lateral line. Spermathecae (Fig. 14l) paired in *viii*.

DISTRIBUTION. *Introduced records.* Brazil, Madagascar, Seychelles, India, Sri Lanka, Queensland, Fiji, Hawaii.

REMARKS. *P. taprobanae* has been reported several times from outside of the *Pheretima* domain (Gates, 1970c). Its homeland is unknown but the species may come from southeast Asia since the numerical studies (see above) reveal that *taprobanae* has higher affinities with *iizukai* (from Japan) and *sempolensis* (from Java) than with representatives from New Guinea where it has been suggested that this taxon may have originated (Gates, 1972a).

MATERIAL EXAMINED. *Previously reported.* 1C Sri Lanka; BMNH 1904.10.5.165 (syntype of *taprobanae*). 6A Sri Lanka; BMNH 1972.1.6-11 (syntypes of *taprobanae*). 3C Northeast Madagascar; Hamburg v6935 (*taprobanae*: Michaelsen, 1907). 2C Sri Lanka; BMNH 1904.10.5.163-164 (*taprobanae*: Sims & Easton, 1972). 1C Brazil; Hamburg v9681 (*taprobanae* Michaelsen, 1927). *New records.* 15C, 8A Sri Lanka; BMNH 1904.10.5.1286-1296. 12C, 3A Queensland, Australia; BMNH 1972.11.67-73, 1973.14.272-279. 3C, 1A Suva point, Fiji; BMNH 1968.4.85-88. 1C Seychelles; BMNH 1977.21.4.

OTHER MATERIAL REPORTED. 1 specimen Sri Lanka (*taprobanae*: Michaelsen, 1903). 3 specimens Travencore, India (*taprobanae*: Aiyer, 1929). 6C Sri Lanka (*taprobanae*: Gates, 1945). 6 specimens Sri Lanka; Hamburg v4662 (syntypes of *pauli*) although this series is listed in the catalogue of the Hamburg Museum it could not be located during the preparation of this paper. 2C, 4A Brazil (*taprobanae pauli*: Moreira, 1903). Oahu, Hawaii (*taprobanae*: Gates, 1972) this material was identified by Dr G. E. Gates who included the record in his monograph on Burmese earthworms, although it was not noted as a new record (Gates, private communication).

Polypheretima grata (Cognetti, 1914)

Pheretima (*Parapheretima*) *grata* Cognetti, 1914 : 362; Ude, 1932 : 164.

Metapheretima grata: Sims & Easton, 1972 : 180, 233.

DIAGNOSIS. *Polypheretima* with male pores within copulatory pouches; spermathecal pores in furrows 5/6/7. Holandric. Stalked glands discharge into copulatory pouches and through papillae associated with spermathecal pores.

DESCRIPTION. *External characters.* Length 110-140 mm, diameter *c.* 4 mm. 83-100 segments. Clitellum *xiv-xvi*. First dorsal pore 13/14. Setae, *c.* 53 on *vii*, *c.* 68 on *xx*, setal ring regular (*aa = ab = yz = zz*).

Male pores on squat conical penes within copulatory pouches *c.* 0.30 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 5/6/7, *c.* 0.50 body circumference apart.

Genital markings (Fig. 17c), small, simple papillae in paired clusters of up to 6, median to the spermathecal pores, postsetal on *vi*.

Internal characters. Septa 5/6-9/10 membranous, 10/11-13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x-xiii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles in *xi* and *xii*, extending to the lateral line, those of *xi* enclosed in the testes sacs. Pseudoseminal vesicles large, *xiii*. Copulatory pouches large, well developed occupying the coelom. Male pores on squat conical penes. Up to 12 stalked glands discharge through small papillae with the copulatory pouches. Spermathecae (Fig. 14m) paired in *vi* and *vii*.

Stalked glands discharge through the genital markings on *vi* and into the copulatory pouches.

DISTRIBUTION. New Guinea.

REMARKS. The results of the numerical investigations (see above) could be interpreted as indicating that this species is closely allied to the *bifaria* species-group. If this is so then the copulatory pouches would have evolved independently of their development of other species of *Polypheretima* (*polytheca*, *patae* and *badia* species-groups).

MATERIAL EXAMINED. *Previously reported*. 2C Sepik river, Papua New Guinea (Cognetti also provided the following co-ordinates 4° 4' 18" S, 140° 7' 15" E. These lie a considerable distance from the Sepik river but it has not been possible to establish which data are correct); Leiden 1819 (syntypes of *grata*). 8C Sepik river, Papua New Guinea; Berlin 6466, 6467 (*grata*: Ude, 1932). *New record*. 1C Mt Wilhelmina, West Irian; Bogor Ann 065.

Polypheretima voeltzkowi (Michaelsen, 1907)

Pheretima voeltzkowi Michaelsen, 1907 : 45.

Metapheretima voeltzkowi: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with simple male pores; paired spermathecal pores on the postsetal region of *v*. Holandric.

DESCRIPTION. *External characters*. Length 40–68 mm, diameter 2.5–3.5 mm. 85–88 segments. Clitellum *xiv*–*xvi*. First dorsal pores 12/13. Setae, 55–60 on *vii*, 50–70 on *xx*, setal ring regular (*aa* = *ab* = *yz* = *zz*).

Male pores simple on large circular porophores *c.* 0.30 body circumference apart. Female pores paired. Spermathecal pores paired, segmental on the postsetal region of *v*, close to the intersegmental furrow, *c.* 0.66 body circumference apart.

Genital markings (Fig. 17b) simple, paired, postsetal on *xvii*, pre- and postsetal on *xviii*, median to the male pores.

Internal characters. Septa 5/6/7 thickened, 7/8–13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x*–*xii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles slim, extending to the dorsal line in *xi* and *xii*. Spermathecae (Fig. 14n) paired in *v*, occasionally absent.

DISTRIBUTION. Comoro Islands.

REMARKS. *P. voeltzkowi* is known only from the type series. Michaelsen (1907) recorded that the spermathecal pores are intersegmental in furrow 5/6 but re-examination of the type series revealed that they are on the postsetal portion of segment *v* close to the intersegmental furrow.

The Comoro Islands are outside of the presently accepted range of *Polypheretima* and indeed of the *Pheretima* domain. Numerical studies (see above) revealed that this species has high affinities with the Papuan representatives of the *P. bifaria* species-group and it is possible that the occurrence of *voeltzkowi* in the Comoro Islands is the result of accidental introduction by man.

MATERIAL EXAMINED. 3C Great Comoro, Comoro Islands; Hamburg v6936 (syntypes of *voeltzkowi*). 5C Data as above; Berlin 4946 (syntypes of *voeltzkowi*).

Polypheretima polytheca species-group

DIAGNOSIS. Holandric species of *Polypheretima* with male pores within copulatory pouches which lack stalked glands discharging into them.

DISTRIBUTION. Indochina, Malaya, Borneo, Western Indonesia.

SPECIES INCLUDED. *annamensis*, *aridgeana*, *elongata* species-complex (*elongata*, *everetti*, *kina-baluenis*, *phacellotheca*, *stelleri*), *koyana*, *lesonea*, *pentacystis*, *polytheca*, *renschii*.

REMARKS. With the exception of *P. grata* all the holandric species of *Polypheretima* with specialized male pores are included in this species-group. *P. grata* may be distinguished by the possession of

Table 7 Marker characters of the members of the *Polypheretima polytheca* species-group

Species	Spermathecal furrows	Number of spermathecae per battery ¹	Separation of spermathecal batteries	Indigenous distribution
<i>pentacystis</i>	4/5/6/7/8/9	1	0·62	? Madagascar ? Seychelles
<i>polytheca</i>	5/6/7/8/9	6–10	0·28	Malaya
<i>koyana</i>	5/6/7/8/9	up to 9	0·20	Borneo
<i>lesonea</i>	5/6/7/8/9 or 6/7/8/9	1(5/6/7), 1–2 (7/8), 8–10(8/9)	0·25	Sumatra
<i>elongata</i> species-complex	5/6, 5/6/7 or 6/7	1–28	0·25	Sangihe, Kepulauan Taulaud, Celebes, Buru, Balabac Is., Borneo, ? Madura, East Java, Bali, Lombok, Sumbawa, Komodo, Gt Bastard Is.
<i>aringeana</i> ²	5/6/7	7–10	0·50	Malaya
<i>annamensis</i>	6/7	1	0·20	Vietnam
<i>renschii</i>	7/8/9	1	? 0·25	Flores

¹ Species with paired spermathecae are coded as 1.

² *aringeana* may also be recognized by the form of its genital markings (see Figs 4e and 21b).

stalked glands discharging into the copulatory pouches and the small, numerous genital markings associated with the spermathecal pores.

Marker characters of the species included in the *polytheca* species-group are given in Table 7.

Polypheretima pentacystis (Rosa, 1891)

Perichaeta pentacystis Rosa, 1891 : 400; Beddard, 1895 : 422.

Amyntas pentacystis: Michaelsen, 1899 : 95; Beddard, 1900a : 614.

Pheretima pentacystis: Michaelsen, 1900 : 293.

Metapheretima pentacystis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with male pores in copulatory pouches; paired spermathecal pores about three fifths of the body circumference apart in furrows 4/5/6/7/8/9. Holandric.

DESCRIPTION. *External characters*. Length 110–124 mm, diameter 5–6 mm. 82–113 segments. Clitellum *xiv*–*xvi*. First dorsal pore 13/14. Setae, 65–75 on *vii*, 80–86 on *xx*, setal ring regular with ventral gaps ($aa = 2ab = 2yz = 2zz$).

Male pores on squat conical penes within copulatory pouches *c.* 0·27 body circumference apart. Female pores paired. Spermathecal pores small, paired, intersegmental in 4/5/6/7/8/9, more widely separated anteriorly than posteriorly, *c.* 0·82 body circumference apart at 4/5, *c.* 0·62 body circumference apart at 8/9.

Genital markings (Fig. 21a) large, simple, paired, presetal on *viii*, *xvii* and *xix* slightly median to the line of the male pores.

Internal characters. Septa 5/6–7/8 thickened, 8/9 membranous, 9/10–12/13 thickened. Intestine begins in *xiv*. Lateral hearts in *x*–*xiii*.

Holandric, testes sacs paired in *x* and *xi* but linked dorsally by a narrow connection, seminal vesicles large, reaching the dorsal line in *xi* and *xii*. Copulatory pouches extending into the coelom. Spermathecae (Fig. 15a) paired in *v*–*ix*.

DISTRIBUTION. Seychelles, Madagascar.

REMARKS. The only records of *pentacystis*, the Seychelles and Madagascar, are from outside of the classical domain of the *Pheretima* group of genera. Presumably the species has been introduced into these islands by the agency of man. It is interesting to note that the variations in sizes and distributions of the spermathecal batteries among the other species of the *polytheca* species-group are clinal and if these trends were to be projected southwestwards from the range of the group, a form with five thecal segments and paired spermathecae would be expected to occur in the Seychelles–Madagascar area. At present, there are no explanations available to provide a mechanism for the dispersal of the *polytheca* species-group into this region.

Due to the extreme dorsal situation of the spermathecal pores in *pentacystis*, during copulation torsion of the anterior portion of the body may be necessary by both partners so as to apply the ventral region possessing the male pores to the region of the spermathecal pores. Possibly this behavioural requirement may act as a barrier preventing successful copulation between *pentacystis* and its siblings in the *polytheca* species-group.

MATERIAL EXAMINED. 1C Mahe Island, Seychelles; Wein 3996 (holotype of *pentacystis*). 1C Nossi-be, Madagascar; Hamburg v5113 (*pentacystis*: Michaelsen, 1899).

Polypheretima polytheca (Beddard, 1900)

Amyntas polythecus Beddard, 1900b : 897.

Pheretima polytheca: Stephenson, 1932 : 229; (= *minuta*) Gates, 1935 : 89.

Pheretima (Polypheretima) polytheca: Michaelsen, 1934b : 16.

Metapheretima polytheca: Sims & Easton, 1972 : 181, 233. [non *Pheretima polytheca aruensis* Michaelsen, 1910a : 252. *Pheretima (Polypheretima) polytheca aruensis*: Michaelsen, 1934b : 16, 29. *Metapheretima polytheca aruensis*: Sims & Easton, 1972 : 233 (= ? *Polypheretima bifaria*).]

Amyntas minutus Beddard, 1900b : 906. [non *Pheretima minuta* Gates, 1929 : 18 (= *Amyntas exiguus*).]

Pheretima minuta: Stephenson, 1932 : 222.

Pheretima (Polypheretima) minuta: Michaelsen, 1934b : 16.

Metapheretima minuta: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with male pores in shallow copulatory pouches about one quarter of the body circumference apart; numerous spermathecal pores in paired batteries about one third of the body circumference apart in furrows 5/6/7/8/9. Holandric.

DESCRIPTION. *External characters*. Length 44–50 mm, diameter 1.5–2 mm. 84–105 segments. Clitellum *xiv*–*xvi*. First dorsal pore 12/13. Setae, 45–50 on *vii*, 40–50 on *xx*, setal ring regular with dorsal and ventral gaps ($aa = 2ab = 2yz = zz$).

Male pores on large circular porophores within shallow copulatory pouches *c.* 0.24 body circumference apart. Female pore single. Spermathecal pores small, numerous in paired batteries of 6–10 pores intersegmental in 5/6/7/8/9 *c.* 0.28 body circumference apart.

Genital markings (Fig. 21b), simple paired, presetal on *vi* and *viii* slightly median to the spermathecal batteries, on *xvii*, *xix*–*xxi* slightly median to the line of the male pores.

Internal characters. Septa 5/6–7/8 thickened, 8/9/10 absent, 10/11–12/13 thickened. Intestine begins in *xv*. Lateral hearts in *x*–*xii*.

Holandric, testes sacs large, paired in *x* and *xi*, extending to the dorsal line and in *xi* enclosing the lateral hearts and seminal vesicles, seminal vesicles large, extending to the dorsal line in *xi* and *xii*. Pseudoseminal vesicles well developed in *xiii*. Copulatory pouches shallow, confined to the body wall. Spermathecae (Fig. 15b) numerous, arranged in paired, batteries of 6–10 spermathecae in *vi*–*ix*.

DISTRIBUTION. Kelantan, Malaya.

REMARKS. The taxon *polytheca aruensis*, described by Michaelsen (1910) from material collected in the Aru Islands, is tentatively placed in the synonymy of *Polypheretima bifaria* mainly on the arrangement of genital markings.

MATERIAL EXAMINED. 1C Kelantan, Malaya; BMNH 1924.3.1.249 (holotype of *polytheca*). 1C Kelantan, Malaya; BMNH 1924.3.1.219 (holotype of *minuta*).

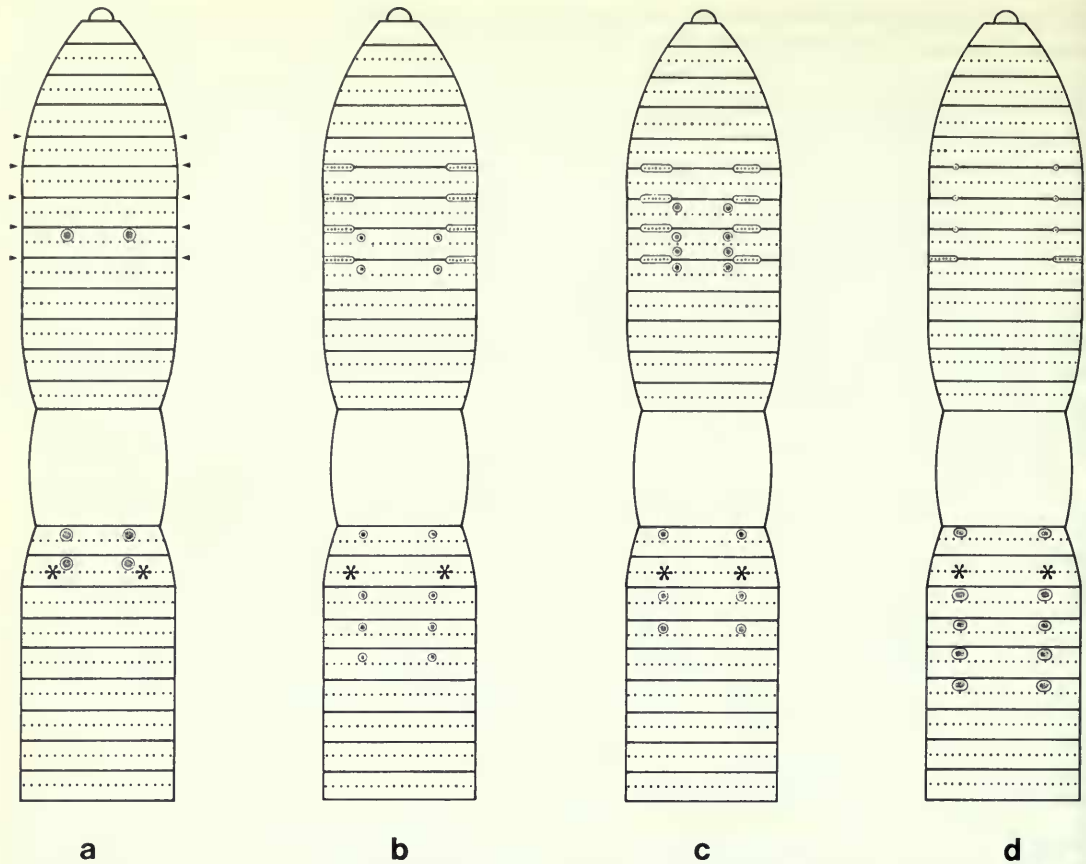


Fig. 21 Anterior ventral surface, diagnostic characters. (For ontogenetic variation of the male pores, see Fig. 3.) (a) *Polypheretima pentacystis*, arrows indicate furrows with dorsal spermathecal pores; (b) *P. polytheca*; (c) *P. koyana*; (d) *P. lesonea* sp. nov.

Polypheretima koyana (Michaelsen, 1934)

Pheretima (*Polypheretima*) *koyana* Michaelsen, 1934b : 29.

Metapheretima koyana: Sims & Easton, 1972 : 180, 233.

DIAGNOSIS. *Polypheretima* with male pores within large copulatory pouches about one fifth of the body circumference apart; numerous spermathecal pores in paired batteries about one fifth of the body circumference apart in furrows 5/6/7/8/9. Holandric.

DESCRIPTION. *External characters.* Length 125–230 mm, diameter 3.5–5 mm. 162–175 segments. Clitellum *xiv*–*xvi*. First dorsal pore 12/13. Setae, 40–45 on *vii* and *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), and with dorsal and ventral gaps on postclitellar segments ($aa=1.5ab=1.5yz=zz$).

Male pores on squat conical penes within crescentic copulatory pouches $c. 0.17$ body circumference apart. Female pore single or paired. Spermathecal pores small, numerous, in paired batteries of up to 9 pores, intersegmental in 5/6/7/8/9, $c. 0.20$ body circumference apart.

Genital markings (Fig. 21c) simple, paired, presetal on *vii*–*ix*, and postsetal on *viii*, slightly median to the spermathecal batteries, presetal on *xvii*, *xix*–*xx*, slightly median to the male pores. *Internal characters.* Septa 5/6–7/8 thickened, 8/9/10 absent, 10/11–13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x*–*xiii*.

Holandric, testes sacs small, paired, ventral in *x* and *xi*, seminal vesicles large, reaching the dorsal line in *xi* and *xii*. Pseudoseminal vesicles in *xiii*. Copulatory pouches large, extending into

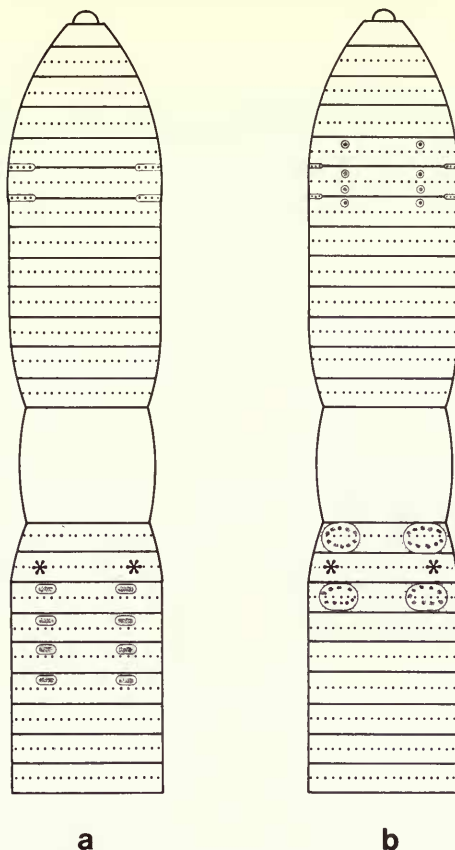


Fig. 22 Anterior ventral surface, diagnostic characters. (For ontogenetic variation of the male pores see Fig. 3.) (a) *Polypheretima elongata*; (b) *P. aringana*.

the coelom. Spermathecae (Fig. 15c), numerous, arranged in paired batteries of up to 9 spermathecae in *vi-ix*.

DISTRIBUTION. Mt Dulit, Sarawak.

MATERIAL EXAMINED. 2C, 6A Mt Dulit, Sarawak; BMNH 1933.10.6.21-25 (syntypes of *koyana*). 3C, 2A Data as above; Hamburg v11954, v11952 (syntypes of *koyana*).

Polypheretima lesonea sp. nov.

DIAGNOSIS. *Polypheretima* with male pores within copulatory pouches about one third of the body circumference apart; paired spermathecal pores in furrows 6/7/8 and often 5/6, numerous, spermathecal pores in paired batteries in 8/9. Holandric.

DESCRIPTION. *External characters*. Length 73-88 mm, diameter 2-3 mm. 112-131 segments. Clitellum *xiv-xvi*. First dorsal pore 11/12. Setae, 34-40 on *vii*, 30-36 on *xx*, setal ring regular with ventral gaps on preclitellar segments ($aa=2ab=2yz=2zz$), and with dorsal and ventral gaps on postclitellar segments ($aa=2ab=2yz=zz$).

Male pores on squat conical penes within copulatory pouches, *c.* 0.33 body circumference apart. Female pore single. Spermathecal pores small, intersegmental, in 6/7/8/9 and occasionally 5/6 also, pores paired in 5/6/7/8, *c.* 0.42 body circumference apart and in paired batteries of 8-10 pores in 8/9 where the ventralmost pores are *c.* 0.42 body circumference apart and the dorsalmost are close to the dorsal line, additional spermathecal pores in 7/8 occasionally.

Genital markings (Fig. 21d) paired, presetal on *xix-xxii* and occasionally *xvii* in line with the male pores.

Internal characters. Septa 5/6-7/8 thickened, 8/9 absent, 9/10 membranous, 10/11-12/13 thickened. Intestine begins in *xvi*. Lateral hearts in *x-xiii*.

Holandric, testes sacs large, paired, reaching the dorsal line in *x* and *xi*, enclosing the lateral hearts and, in *xi*, the seminal vesicles, seminal vesicles small in *xi*, large, reaching the dorsal line in *xii*. Coelomic pouches small, invading the coelom. Spermathecae (Fig. 15d) in *vii-ix* and occasionally *vi*, paired in *vi-viii*, in paired batteries of 8-10 spermathecae in *ix*, additional spermathecae in *viii* occasionally.

DISTRIBUTION. Sumatra.

REMARKS. All of the syntypes of this species have three thecal segments (*vii-ix*) and are bithecal in the first two and polythecal in the last segment. The single individual from Maurarupit has an additional pair of spermathecae in *vi* and is polythecal in *viii* (2 spermathecae in each battery).

MATERIAL EXAMINED. 8C Flat plain mostly covered with sedge grass and scrub trees and with few cultivations or villages, soil damp, loamy, shallow, Sungaikolong, Central Sumatra, 1° 07' S, 101° 48' E, altitude *c.* 50 m, coll G Lincoln 28 May 1973 British University Dragon Expedition; BMNH 1975.7.3-12 (syntypes of *lesonea*). 1C Flat ground beside river, moist black soil and mud, *c.* 5 miles south of Maurarupit, beside road to Lapat, central Sumatra, 2° 45' S, 102° 54' E, altitude *c.* 160 m, coll G Lincoln 5 Jun 1973 British University Dragon Expedition; BMNH 1975.7.2.

Polypheretima elongata species-complex

Metapheretima elongata species-complex Sims & Easton, 1972 : 252; Easton, 1976 : 38.

DIAGNOSIS. *Polypheretima* with male pores in shallow copulatory pouches lacking stalked glands; numerous spermathecal pores in paired batteries in furrows 5/6 and/or 6/7. Holandric, post-clitellar genital markings one pair per segment, simple presetal near to the line of the male pores.

DESCRIPTION. *External characters.* Length 40-360 mm, diameter 1.5-10 mm. 100-220 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae 20-130 on *vii*, 36-86 on *xx*, occasionally setae *a* and *b* enlarged, setal ring regular with ventral gaps ($aa = 1.5ab = 1.5yz = 1.5zz$).

Male pores on squat penes within shallow copulatory pouches *c.* 0.25 body circumference apart. Female pore single. Spermathecal pores small, numerous arranged in paired ventrolateral batteries, of up to 28 pores, intersegmental in 5/6 and/or 6/7, occasionally absent.

Genital markings (Fig. 22a) simple, large, paired presetal on *xix* and successive segments in line with or slightly median to the male pores, occasionally on *vi*, *vii* and *xvii*.

Internal characters. Septa 4/5-7/8 thickened, 8/9 membranous, 9/10 absent, 10/11-13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x-xii* and usually *xiii*.

Holandric, testes sacs large, paired, extending to the dorsal line in *x* and *xi*, seminal vesicles paired in *xi* and *xii*, the anterior pair enclosed in the testes sacs. Pseudoseminal vesicles in *xiii* and *xiv*. Copulatory pouches shallow, confined to the body wall. Spermathecae (Fig. 15e) numerous in paired batteries of up to 28 spermathecae in *vi* and/or *vii*, occasionally absent.

DISTRIBUTION. *Indigenous records.* Kepulauan Taulaud; Sangihe; Celebes; Buru; Balabac Island, Palawan; Borneo; ? Madura; east Java; Bali; Lombok; Sambawa; Komoda; Gt Bastard Island, Flores.

Four of the five species included in this species-complex are known only from the indigenous range. The fifth, *elongata*, has been introduced into many parts of the world.

REMARKS. The species *elongata*, *everetti*, *kinabaluensis*, *phacellotheca* and *stelleri* form a single species-complex. They may be distinguished from one another by comparisons of the number of setae on *vii* and the size of the spermathecal batteries (Fig. 23). The spermathecal index may be calculated by substituting the mean size of the anterior and posterior spermathecal batteries of an individual for *a* and *b* in the formula $x = \sqrt{(a^2 + b^2)}$. The four species, *everetti*, *phacellotheca*,

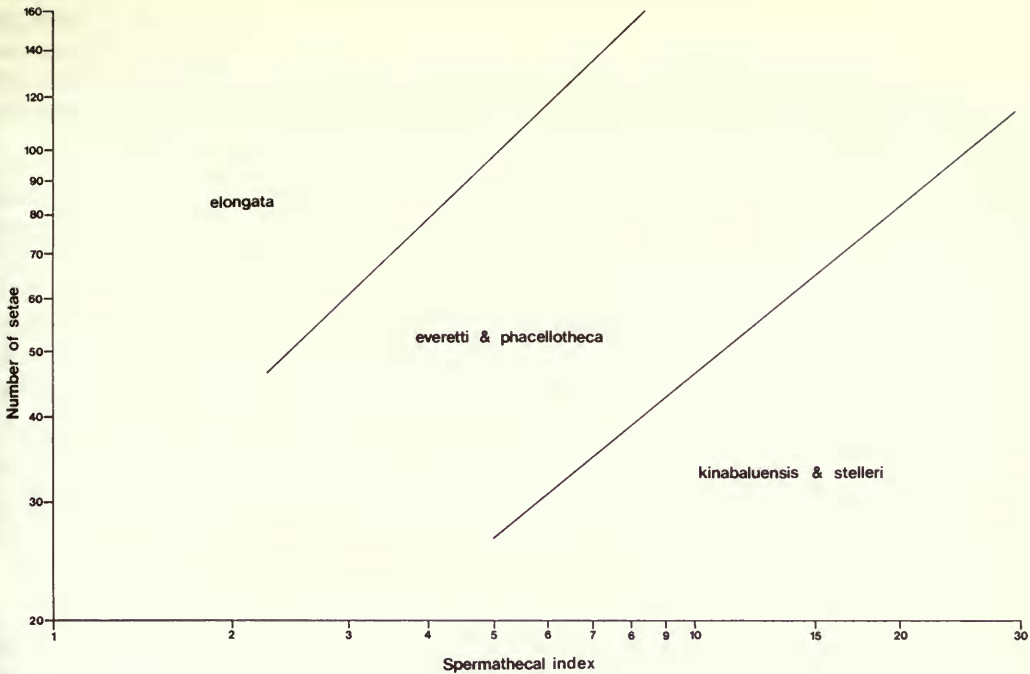


Fig. 23 *Polypheretima elongata* species-complex: correlation between the number of setae on segment *vii* and the spermathecal index, $\sqrt{(a^2 + b^2)}$. (*a* and *b* are the mean number of spermathecae in a battery in furrows 5/6 and 6/7 respectively.)

stelleri and *kinabaluensis*, need additional characters to be assessed for differentiation. In the first pair *everetti* has spermathecal pores in furrows 5/6 and 6/7 while *phacellotheca* has spermathecae in furrow 5/6 only; in the second *stelleri* has numerous setae on *vii* (up to 130) while *kinabaluensis* has few setae (less than 40). Full details of the variation in the setal and spermathecal systems of the members of the *elongata* species-complex are given by Easton (1976).

Polypheretima elongata (Perrier, 1872)

Perichaeta elongata Perrier, 1872 : 124.

Metapheretima elongata: Easton, 1976 : 40.

Perichaeta biserialis Perrier, 1875 : 1044.

Perichaeta acystis Beddard, 1895 : 423.

(For full synonymy see Easton, 1976.)

DIAGNOSIS. *P. elongata* species-complex with numerous setae (usually about 80 on *vii* in clitellate specimens but up to 130 in large individuals); small spermathecal batteries (rarely more than 3 spermathecae in each battery) in furrows 5/6/7 or 5/6 or 6/7 only or absent. Spermathecal batteries usually present in about 50% of the clitellate portion of indigenous populations to only 15% of the clitellate portion of introduced populations (Easton, 1976).

DISTRIBUTION. *Indigenous records*. ? Madura; east Java; Bali; Lombok; Sumbawa; Komodo; ? Gt Bastard Island, Flores; ? southeast Celebes.

Introduced records. South and central America (type locality, Peru), Madagascar, Comoros, Sri Lanka, India, Pakistan, Bangladesh, Burma, Andaman Islands, Thailand, Malaya, Sumatra, west and central Java, Kepulauan Taulaud, Philippines, Taiwan, Kei Islands, Australia, Papua New Guinea, New Britain (new record), New Caledonia, Caroline Islands, Ryukyu Islands, Hawaii, Tahiti, West Indies, Africa. (See Gates, 1972a : 182 for further details.)

REMARKS. Individuals of this species often lack spermathecae. Athecate individuals are especially numerous in introduced populations in which, presumably, specimens without spermathecae reproduced parthenogenetically (Gates, 1972a : 182). The incidence of thecate individuals can be used to establish the indigenous range of the species by analysing the composition of long series (Easton, 1976).

Polypheretima everetti (Beddard & Fedarb, 1895)

Perichaeta everetti Beddard & Fedarb, 1895 : 69.

Perichaeta papillata Beddard & Fedarb, 1895 : 71.

Perichaeta sarawacensis Beddard & Fedarb, 1895 : 71.

Perichaeta barami Michaelsen, 1896 : 203.

Amyntas stelleri seriatus Michaelsen, 1899 : 44.

Amyntas stelleri klabatensis Michaelsen, 1899 : 46.

Amyntas stelleri bonensis Michaelsen, 1899 : 45 [non *Pheretima* (*Pheretima*) *stelleri bonensis*: Michaelsen, 1934a : 108 (= *P. phacellotheca*)].

Pheretima stelleri koroensis Michaelsen, 1910b : 109.

Pheretima stelleri mahakkami Michaelsen, 1922 : 25.

Pheretima (*Pheretima*) *beranensis* Michaelsen, 1928a : 23.

Pheretima (*Polypheretima*) *beranensis tinjarana* Michaelsen, 1934b : 25.

Pheretima (*Pheretima*) *baritoensis* Michaelsen, 1932 : 9.

Metapheretima everetti: Easton, 1976 : 41.

(For full synonymy see Easton, 1976.)

DIAGNOSIS. *P. elongata* species complex with numerous setae (up to 130 on *vii* in large individuals); intermediate sized spermathecal batteries (usually 6–12 spermathecae in each battery of large individuals) in furrows 5/6/7. Spermathecal batteries present in acitellate as well as clitellate individuals (Easton, 1976).

DISTRIBUTION. Balabac Island, Palawan (type locality); north and west Celebes; Borneo (up to 2400 m); Lombok (c. 350–450 m only).

This species is unknown outside its indigenous range.

REMARKS. On Lombok this species has been recorded only from localities at altitudes between 350 and 450 m. Samples from lower altitudes contained the species *elongata* which is rare at higher altitudes. No samples of earthworms are known from above 450 m on Lombok. Although altitudes would appear to be the primary factor governing the distribution of *everetti* (and *elongata*), it should be noted that, on Lombok, the samples of *everetti* were from natural woodland (those of *elongata* being from cultivated land). All the records of *everetti* (also *stelleri* and *phacellotheca*) from Celebes are from the northern and western region, an area of forest. On Mt Kinabalu, Borneo, the species *everetti* occurs at altitudes up to 2400 m, being sympatric from 2100 m with the high altitude species *kinabaluensis*. Although on both Lombok and Mt Kinabalu *everetti* is sympatric with other members of the *elongata* species-complex, there is no indication of hybridization among them.

Beddard & Fedarb (1895) reported that the type locality of *Perichaeta everetti* is Mt Kinabalu, Sabah but Easton (1976) redesignated Balabac Island, Palawan as the type locality under Recommendation 72E of the International Code of Zoological Nomenclature.

Polypheretima kinabaluensis (Beddard & Fedarb, 1895)

Perichaeta kinabaluensis Beddard & Fedarb, 1895 : 71.

Metapheretima kinabaluensis: Easton, 1976 : 41.

(For full synonymy see Easton, 1976.)

DIAGNOSIS. *P. elongata* species-complex with few setae (less than 40 on *vii*); intermediate sized spermathecal batteries (usually 6–12 spermathecae in each battery of large individuals) in furrows 5/6/7. Spermathecal batteries present in acitellate as well as clitellate individuals (Easton, 1976).

DISTRIBUTION. Mt Kinabalu, Sabah. 2100–2750 m (type locality Tamburgare, 2350 m).

This species has not been recorded outside its indigenous range.

REMARKS. This species is known only from high altitudes on Mt Kinabalu where there is a specialized montane fauna and flora. Although samples collected on Mt Kinabalu at 2100 and 2400 m contained both *everetti* and *kinabaluensis*, there is no indication of hybridization.

Polypheretima phacellotheca (Michaelsen, 1899)

Amyntas phakellotheca (sic) Michaelsen, 1899 : 47.

Metapheretima phacellotheca: Easton, 1976 : 44.

(For full synonymy see Easton, 1976.)

DIAGNOSIS. *P. elongata* species-complex with numerous setae (up to 80 on *vii* in large individuals); large spermathecal batteries (9–12 spermathecae in each battery of large individuals) in furrow 5/6 only. Spermathecal batteries present in ac clitellate as well as clitellate individuals (Easton, 1976).

DISTRIBUTION. Northeast Celebes (type locality; Mt Masarang, near Tomohon), Buru.

REMARKS. This species is the only member of the *elongata* species-complex known from Buru which is the most easterly indigenous record of the complex. Morphologically it closely resembles *stelleri* from which it may be distinguished by the restriction of spermathecal batteries to furrow 5/6.

Polypheretima stelleri (Michaelsen, 1891)

Perichaeta stelleri Michaelsen, 1891 : 39.

Amyntas stelleri annectens Michaelsen, 1899 : 42.

Metapheretima stelleri: Easton, 1976 : 44.

(For full synonymy see Easton, 1976.)

DIAGNOSIS. *P. elongata* species-complex with numerous setae (up to 130 on *vii* in large individuals); very large spermathecal batteries (up to 28 spermathecae in each battery of large individuals) in furrows 5/6/7. Spermathecal batteries present in ac clitellate as well as clitellate individuals (Easton, 1976).

DISTRIBUTION. Sangihe (type locality), Kepulauan Taulaud, Celebes (Bone valley and Matinang range).

This species has not been encountered outside its indigenous range.

REMARKS. In Celebes *stelleri* has been recorded from Bone valley (c. 400 m) and the Matinang range (c. 1500 m) together with *everetti*.

Polypheretima aringeanus (Beddard, 1900)

Amyntas aringeanus Beddard, 1900b : 899.

Pheretima argineana: Stephenson, 1932 : 203.

Pheretima (*Polypheretima*) *aringeana*: Michaelsen, 1934b : 16.

Metapheretima aringeanus: Sims & Easton, 1972 : 180, 233.

DIAGNOSIS. *Polypheretima* with male pores in shallow copulatory pouches lacking stalked glands; numerous spermathecal pores arranged in paired batteries, in furrows 5/6/7. Holandric, post-clitellar genital markings, 1 pair per segment, central portion of each marking differentiated into several small pigmented areas (Fig. 4e, 22b).

DESCRIPTION. *External characters*. Length 60–200 mm, diameter 3–5 mm. 100–150 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, 60–70 on *vii*, and *xx*, setal ring slightly crowded ventrally with ventral gaps on preclitellar segments ($aa = 1 \cdot 5ab = 2yz = 2zz$), evenly spaced on post-clitellar segments ($aa = ab = yz = zz$).

Male pores on large conical penes within copulatory pouches c. 0.27 body circumference apart. Female pore single. Spermathecal pores numerous, arranged in paired, lateral batteries of 7–10 pores, intersegmental in 5/6/7, c. 0.50 body circumference apart.

Genital markings (Fig. 22b) simple paired presetal on *v-vii* and postsetal on *v* and *vi*, slightly median to the spermathecal batteries; large paired markings differentiated central areas, occupying the whole length of the segment, in line with the male pores on *xvii* and *xix*.

Internal characters. Septa 4/5-7/8 thickened, 8/9/10 absent, 10/11-12/13 thickened. Intestine begins in *xv*. Lateral hearts in *x-xiii*.

Holandric, testes sacs annular in *x* and *xi*, enclosing the lateral hearts and, in *xi*, the seminal vesicles, seminal vesicles small in *xi*, large in *xii*. Pseudoseminal vesicles large in *xiii*. Copulatory pouches shallow, confined to the body wall. Spermathecae (Fig. 15f), numerous, arranged in paired batteries of 7-10 spermathecae in *vi* and *vii*.

DISTRIBUTION. Malaya.

MATERIAL EXAMINED. *Previously reported.* 3C, 4A Kelantan, Malaya; BMNH 1904.10.5.1000-1001, 1924.3.1.232-234 (syntypes of *arangeana*), other specimens from this series are deposited at Cambridge, England, they were not examined.

New record. 11C, 6A, Kelantan, Malaya; BMNH 1972.12.9-11, 1977.9.1-9.

Polypheretima annamensis (Stephenson, 1931)

Pheretima annamensis Stephenson, 1931 : 60.

Metapheretima annamensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with male pores in copulatory pouches; paired spermathecal pores about one fifth of the body circumference apart in furrow 6/7 only. Holandric.

DESCRIPTION. *External characters.* Length 84-87 mm - both of the specimens on which this description is based are immature, adult individuals may be expected to be considerably larger - diameter *c.* 6 mm. *c.* 177 segments. Clitellum *xiv-xvi*. First dorsal pore 11/12. Setae, 82-86 on *vii*, *c.* 94 on *xx*, setal ring regular on preclitellar segments ($aa = ab = yz = zz$), with ventral gaps on postclitellar ($aa = 1.5ab = 1.5yz = 1.5zz$).

Male pores on squat penes within large copulatory pouches *c.* 0.23 body circumference apart. Female pores not detected. Spermathecal pores paired, intersegmental in 6/7, *c.* 0.20 body circumference apart.

Genital markings absent.

Internal characters. Septa 5/6-7/8 thickened, 8/9/10 absent, 10/11-13-14 thickened. Intestine begins in *xv*. Lateral hearts in *x-xiii*.

Holandric, testes sacs of *x* annular, those of *xi* small, paired lateral, seminal vesicles large in *xi* and *xii*, reaching the dorsal line. Copulatory pouches shallow, confined to the body wall. Spermathecae (Fig. 15g) paired in *vii*.

DISTRIBUTION. South Vietnam.

MATERIAL EXAMINED. 1C, 1A Lang Bian Peaks, South Vietnam; BMNH 1930.2.7.10-11 (syntypes of *annamensis*).

Polypheretima renschi (Ude, 1932)

Pheretima (Pheretima) renschi Ude, 1932 : 141.

Metapheretima renschi: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with male pores in copulatory pouches; paired spermathecal pores in furrows 7/8/9. Holandric.

DESCRIPTION. *External characters.* Length 220-250 mm, diameter 8-12 mm. *C.* 160 segments. Clitellum *xiv-xvi*. Position of first dorsal pore not recorded. Setae, *c.* 72 on *vii*, *c.* 80 on *xiii*, small, widely spaced.

Male pores within copulatory pouches separated by 18 setae (estimated to be *c.* 0.25 body circumference apart). Female pores not recorded. Spermathecal pores paired, intersegmental in 7/8/9, separated by 18 setae (estimated to be *c.* 0.25 body circumference apart).

Genital markings absent.

Internal characters. Septa 7/8 membranous, 8/9 and probably 9/10 absent, 10/11–14/15 thickened. Intestine begins in *xv*. Disposition of lateral hearts not recorded.

Holandric, testes sacs paired, median in *x* and *xi*, seminal vesicles in *xi* and *xii*. Copulatory pouches confined to body wall, penes conical. Spermathecal, paired in *viii* and *ix*, ampulla sac shaped with a distinct, long, narrow duct. Diverticula three times as long as main duct with a bean shaped ampulla.

Description after Ude (1932).

DISTRIBUTION. Flores.

RECORDS. 2 specimens, west Flores (syntypes of *renschii*).

Polypheretima badia species-group

DIAGNOSIS. *Polypheretima* with a pair of simple presetal genital markings on each of several postclitellar segments. Metandric.

DISTRIBUTION. Lombok, Flores.

SPECIES INCLUDED. *badia*, *elberti*, *kellneri*, ? *sibogae*, *swelaensis*.

REMARKS. The metandric species of *Polypheretima* form two species-groups. Those from Papua are placed in the *patae* species-group, while those from the Lesser Sunda Islands comprise the *badia* species-group. The numerical investigation carried out during this revision indicate that these two groups are closely related in spite of their separate distributions. The oligochaete fauna of the area between these two species-groups is poorly known and it is uncertain whether the two groups are the end members of a continuous group of metandric species.

One species, *sibogae*, can be only tentatively assigned to the *badia*-group since data regarding its anterior male organs are deficient but the high affinities of this species with the other members of the species-group (see numerical studies) indicate that it is probably metandric.

The relationships among the taxa assigned to this group have not been studied in detail. Two of the species, *badia* and *swelaensis*, are certainly closely allied and possibly conspecific since the regions of their male pores are modified in the form of slight ridges which extend from *xvii* to *xix*.

Marker characters of the species assigned to the *badia* species-group are given in Table 8.

Table 8 Marker characters of the members of the *Polypheretima badia* species-group

Species	Spermathecal furrows	Separation of spermathecal pores	Setal number on <i>vii</i> (for segmental volume of <i>c.</i> 50 mm ³)	Distribution
<i>kellneri</i>	4/5/6/7/8/9	0.50	30–40	Lombok
<i>sibogae</i>	4/5/6/7/8/9	0.40 (polythecal)	<i>c.</i> 200	Lombok
<i>badia</i>	4/5/6/7/8/9, 5/6/7/8/9 or ? 6/7/8/9	0.33	30–40	Flores ? Lombok
<i>elberti</i>	5/6/7/8/9	0.45	30–40	Lombok
<i>swelaensis</i>	5/6/7/8	0.37	60–80	Lombok

Polypheretima kellneri (Ude, 1932)

Pheretima (*Metapheretima*) *kellneri* Ude, 1932 : 177.

Metapheretima kellneri: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about one half of the body circumference apart in furrows 4/5/6/7/8/9. Metandric.

DESCRIPTION. *External characters.* Length *c.* 180 mm, diameter *c.* 4 mm. Segment number not recorded. Clitellum *xiv*–*xvi*. Setae, *c.* 42 on *viii*, *c.* 60 on *ix*, *c.* 62 on *xvi*, *c.* 65 on *xxi*, setal ring regular (*aa* = *ab* = *yz* = *zz*).

Male pores simple, *c.* 0.40 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 4/5/6/7/8/9, *c.* 0.50 body circumference apart.

Genital markings absent.

Internal characters. Anterior septa present and those anterior to 13/14 slightly thickened. Intestine begins in *xv*. Disposition of lateral hearts not recorded.

Metandric, testes sacs paired in *xi*, seminal vesicles large in *xii*. Spermathecae, paired in *v-ix*, ampulla sac shaped with a short, poorly differentiated duct, diverticular slightly longer than main portion and with a cylindrical end chamber.

Description after Ude (1932).

DISTRIBUTION. Lombok.

REMARKS. *P. kellneri* is known only from the type series whose members lacked genital markings. It is probable that when more (mature) material becomes available individuals will be found with genital markings resembling the markings of other members of the *badia* species-group.

RECORDS. Lombok (type(s) of *kellneri*). Ude (1932) recorded this material as being in the Berlin Museum but no record of it could be found during the preparation of this paper; Dr G. Hartwich, personal communication.

Polypheretima sibogae (Michaelsen, 1922)

Pheretima sibogae Michaelsen, 1922 : 23.

Pheretima (Polypheretima) sibogae: Michaelsen, 1934*b* : 16.

Ephemitra sibogae: Sims & Easton, 1972 : 180, 232.

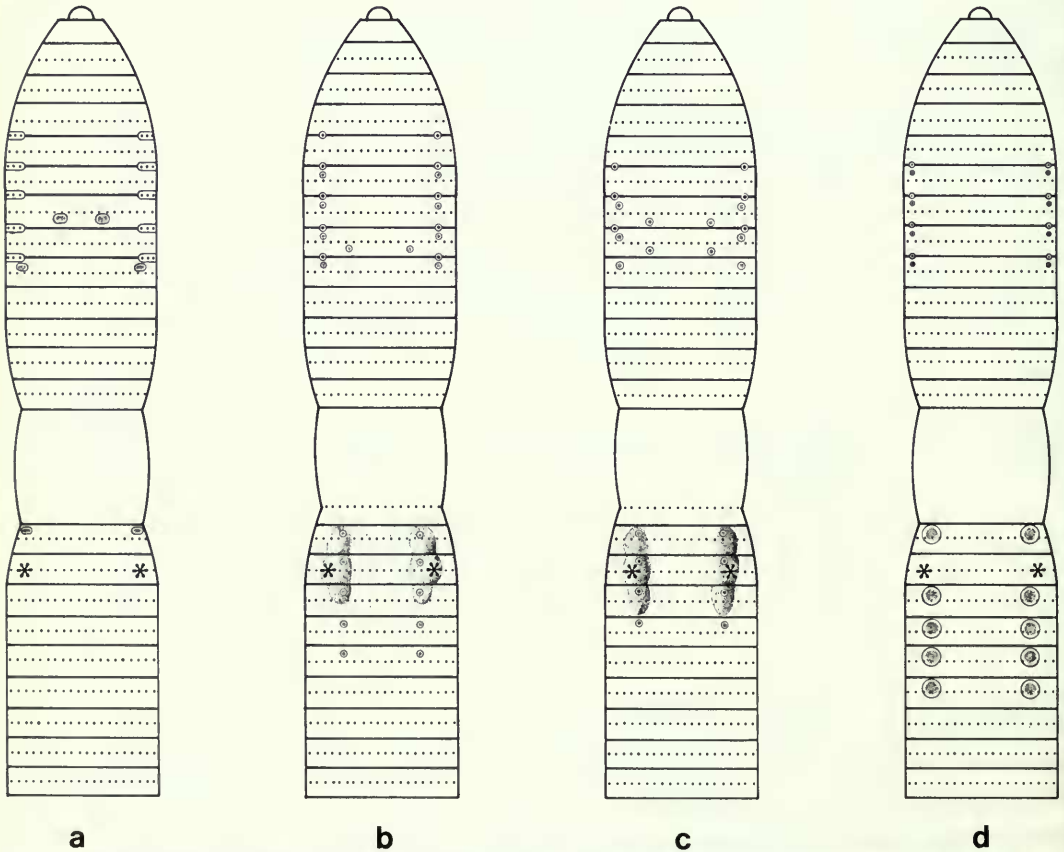


Fig. 24 Anterior ventral surface, diagnostic characters. (For ontogenetic variation of the male pores see Fig. 3.) (a) *Polypheretima sibogae*; (b) *P. badia*; (c) *P. swelaensis*; (d) *P. elberti*.

DIAGNOSIS. *Polypheretima* with numerous spermathecal pores arranged in paired batteries about two fifths of the body circumference apart in furrows 4/5/6/7/8/9. Meroandric. One pair of presetal genital markings on each of several postclitellar segments.

DESCRIPTION. *External characters.* Length *c.* 50 mm, diameter *c.* 3 mm. *C.* 73 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, *c.* 47 on *vii*, *c.* 58 on *xx*, setal ring regular with ventral gaps ($aa = 2ab = 2yz = 2zz$).

Male pores simple, *c.* 0.30 body circumference apart. Female pores paired. Spermathecal pores numerous, arranged in paired batteries of 5–11 pores, intersegmental in 4/5/6/7/8/9, *c.* 0.40 body circumference apart.

Genital markings (Fig. 24a), simple paired, presetal, slightly median to the spermathecal pores in *ix*, postsetal, close to the median line on *vii*, presetal, in line with the male pores on *xvii*.

Internal characters. Anterior septa posterior to 5/6 present, unthickened. Beginning of the intestine not recognized. Disposition of the lateral hearts unknown.

Meroandric (proandric or metandric), testes sacs paired, no other details of the anterior male reproductive system known. Spermathecae (Fig. 15h) numerous in paired batteries of 5–11 spermathecae in *v-ix*.

DISTRIBUTION. Lombok.

REMARKS. *P. sibogae* is known only from the holotype which is poorly preserved. Due to its condition the position of the testes, whether it was proandric or metandric, cannot be established. The species is tentatively included in the *badia* species-group since its genital markings and distribution resemble those of other members of the group.

This species was included within the genus *Ephemitra* (= *Metapheretima* SS) by Sims & Easton (1972) but their decision was based on the assessment of the few characters observable from the holotype. In the present numerical studies *sibogae* has high affinities with the metandric species of *Polypheretima* from Lombok and Flores.

MATERIAL EXAMINED. 1C Lombok; Leiden 1823 (holotype of *sibogae*).

Polypheretima badia (Ude, 1932)

Pheretima (*Metapheretima*) *badia* (? part) Ude, 1932 : 171.

Metapheretima badia: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about one third of the body circumference apart in furrows 5/6/7/8/9 and often 4/5. Metandric. One pair of presetal genital markings on each of several postclitellar segments.

DESCRIPTION. *External characters.* Length 85–160 mm, diameter 3–7 mm. 68–105 segments. Clitellum *xiv-½xvi*. First dorsal pore 11/12 or 12/13. Setae 33–42 on *vii*, 50–70 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple, superficial or slightly invaginated, *c.* 0.33 body circumference apart. Female pores paired. Spermathecal pores paired, intersegmental in 4/5/6/7/8/9, anterior pair (? and next pair) often absent, *c.* 0.33 body circumference apart.

Genital markings (Fig. 24b) simple, paired, presetal on *vi-ix* slightly median to the spermathecal pores, postsetal on *viii* close to the median line, presetal on *xvii-xxiii* median to the male pores. Body wall of *xvii-xix* bearing male pores and genital markings elevated to form paired ridges.

Internal characters. Anterior septa posterior to 5/6 present and membranous or slightly thickened. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs paired in *xi* with narrow dorsal processes, seminal vesicles in *xii*, reaching the dorsal line. Pseudoseminal vesicles in *xiv*. Spermathecae very similar to those of *swelaensis* (Fig. 15j) paired in *v-ix*, anterior pair (? and the next pair) often absent.

DISTRIBUTION. West Flores and (possibly) east Lombok.

REMARKS. *P. badia* was described originally from two series, one collected on Lombok and the other on Flores. The species is now known only from the four extant specimens of the series from

Flores since Easton (1976) found that the single extant specimen from Lombok was the polythecal, holandric species *Polypheretima everetti* (Beddard & Fedarb, 1895). None of these individuals have been dissected so it must be assumed that Ude had other material at his disposal when he described the internal anatomy.

The above description now differs somewhat from the original. In the original account of *badia* the spermathecal pores were reported as being in furrows 5/6/7/8/9 or 6/7/8/9. Of the specimens re-examined from Flores two have spermathecae opening into furrows 5/6/7/8/9 while the other two have spermathecae opening into furrows 4/5/6/7/8/9. It appears that the original description is unreliable, and it is therefore uncertain whether the species occurs on Lombok.

MATERIAL EXAMINED. 4C West Flores; Berlin 7213 (syntypes of *badia*).

Polypheretima elberti (Ude, 1932)

Pheretima (*Metapheretima*) *elberti* Ude, 1932 : 175.

Metapheretima elberti: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about half the body circumference apart in furrows 5/6/7/8/9. Metandric. One pair of presetal genital markings on each of several postclitellar segments.

DESCRIPTION. *External characters.* Length 50–70 mm, diameter 3–4 mm. C. 80 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, *c.* 44 on *vii*, *c.* 72 on *xx*, setal ring slightly crowded dorsally on preclitellar segments ($2aa = 2ab = yz = zz$), regular on postclitellar segments ($aa = ab = yz = zz$).

Male pores on short, conical penes within shallow copulatory pouches *c.* 0.35 body circumference apart. Female pore single. Spermathecal pores paired, intersegmental in 5/6/7/8/9, *c.* 0.45 body circumference apart.

Genital markings (Fig. 24d), small, paired, presetal, in line with the spermathecal pores on *vi–ix*, slightly median to the male pores on *xvii*, *xix–xxi*.

Internal characters. Anterior septa posterior to 5/6 present and membranous. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs paired, ventral in *xi*, seminal vesicles large, extending to the dorsal line in *xii*. Pseudoseminal vesicles absent. Copulatory pouches confined to body wall. Spermathecae (Fig. 15i) paired in *vi–ix*.

DISTRIBUTION. Lombok.

REMARKS. The type series could not be located during the preparation of this paper. New material reported here represent the second record for this species.

MATERIAL EXAMINED. *New record.* 2C Lombok; BMNH 1975.7.314.

OTHER RECORDS. Lombok (syntypes of *elberti*).

Polypheretima swelaensis (Ude, 1932)

Pheretima (*Metapheretima*) *swelaensis* Ude, 1932 : 178.

Amyntas swelaensis: Sims & Easton, 1972 : 237.

? *Pheretima* (*Metapheretima*) *badia* (part) Ude, 1932 : 171.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about one third of the body circumference apart in furrows 5/6/7/8. Metandric. One pair of presetal genital markings on each of several postclitellar segments.

DESCRIPTION. *External characters.* Length *c.* 147 mm, diameter *c.* 5 mm. *c.* 132 segments. Clitellum *xiv–½xvi*. First dorsal pore 12/13. Setae, *c.* 80 on *vii*, *c.* 100 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores on squat penes within shallow copulatory pouches *c.* 0.23 body circumference apart. Female pores paired. Spermathecal pores paired, intersegmental in 5/6/7/8, *c.* 0.37 body circumference apart.

Genital markings (Fig. 24c) paired, presetal, slightly median to the spermathecal pores on *vii-ix*; postsetal, median to the spermathecal pores on *vii-viii*; presetal, slightly median to the male pores on *xvii-xx*. Body wall of *xvii-xix* bearing male pores and genital markings elevated to form paired ridges.

Internal characters. Septa 5/6-13/14 present and slightly thickened. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs small, paired ventral in *xi*, seminal vesicles extending to the dorsal line in *xii*. Copulatory pouches shallow, confined to the body wall. Spermathecae (Fig. 15j) paired in *vi-viii*.

DISTRIBUTION. Lombok.

REMARKS. *P. swelaensis* closely resembles *badia* in the form of the male pores and the spermathecae but it may be distinguished by the separation and arrangement of the spermathecal pores and the higher setal numbers of *swelaensis*.

MATERIAL EXAMINED. *New record.* 1C, 1A Lombok; BMNH 1975.7.13-14.

OTHER RECORDS. Lombok (type(s) of *swelaensis*). The two extant members of the type series, Berlin 7215, are here reidentified as *Amyntas* sp. (Both are athecate and precise identification is impractical.) Lombok; (? *badia*: Ude, 1932).

Polypheretima patae species-group

DIAGNOSIS. *Polypheretima* with numerous genital markings arranged in transverse rows. Metandric.

DISTRIBUTION. New Guinea.

SPECIES INCLUDED. *coplandi*, *huonensis*, *kershawae*, *patae*.

REMARKS. The *patae* species-group contains the metandric *Polypheretimas* from New Guinea. Its members may be recognized by the distributions and separations of the spermathecal pores and, in mature individuals (?), the distribution of genital markings. *P. coplandi*, for example, is known only from four acitellate specimens which lack genital markings. Marker characters of the species included in the *patae* species-group are given in Table 9. It is noteworthy that in species with less than the full complement of spermathecae, reduction has occurred principally in the posterior thecal segments and not, as is common in other species-groups, in the anterior segments.

The affinities of the *patae* group are with the *badia* species-group which includes the metandric forms from the Lesser Sunda Islands (see numerical studies).

Polypheretima patae sp. nov.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about half body circumference apart in furrows 4/5/6/7/8/9. Metandric. Genital markings numerous, presetal in transverse rows.

DESCRIPTION. *External characters.* Length *c.* 75 mm, diameter *c.* 3 mm. 86-94 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae 44-48 on *vii*, 46-51 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), with dorsal gaps on postclitellar segments ($aa=ab=yz=\frac{1}{2}zz$).

Male pores on squat penes within copulatory pouches *c.* 0.24 body circumference apart. Female pores paired spermathecal pores paired, intersegmental in 4/5/6/7/8/9, *c.* 0.55 body circumference apart.

Genital markings (Fig. 25a), transverse rows of *c.* 10 small oval papillae, presetal on *ix*, *xvii-xxii*, lateral limits of rows median to the male pores.

Internal characters. Septa 5/6-13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs paired, extending to the dorsal line in *xi*, seminal vesicles extending to the dorsal line in *xii*. Pseudoseminal vesicles in *xiv*. Copulatory pouches small, only just invading the coelom, penes conical and short. Spermathecae (Fig. 15k) paired in *v-ix*.

DISTRIBUTION. North east New Guinea.

Table 9 Marker characters of the members of the *Polypheretima patae* species-group

Species	Spermathecal furrows	Separation of spermathecal pores	Distribution of genital markings
<i>patae</i>	4/5/6/7/8/9	0.55	presetal only (Fig. 25a)
<i>kershawae</i>	4/5/6/7/8	0.26	pre- and postsetal (Fig. 25b)
<i>coplandi</i>	4/5/6/7	0.42	?
<i>huonensis</i>	5/6/7	0.33	pre- and postsetal (Fig. 25c)

MATERIAL EXAMINED. 1C, 2A In moist soil of dark sandy loam with a high organic matter content and covered with grass and ferns, c. 200 m from sea, just north of Bunu village, 50 km north along coast road from Madang, Papua New Guinea, 4° 52' S, 145° 49' E, coll J W Copland 14 Nov 1971; BMNH 1976.3.186–188 (syntypes of *patae*). 3C, 3A Upper Kaironk valley, Simbai region, Madang district, Papua New Guinea 1900–2100 m, coll R N H Bulmer 14 Nov 1973; BMNH 1976.2.22–27.

Polypheretima kershawae sp. nov.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about one quarter of the body circumference apart in furrows 4/5/6/7/8. Metandric.

Genital markings numerous, pre- and postsetal in transverse rows.

DESCRIPTION. *External characters.* Length 35–45 mm, diameter c. 3 mm. C. 85 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae c. 45 on *vii*, c. 41 on *xx*, setal ring regular ($aa=ab=yz=zz$).

Male pores on short conical penes within copulatory pouches c. 0.24 body circumference apart. Female pores paired. Spermathecal pores paired, intersegmental in 4/5/6/7/8, 0.26 body circumference apart.

Genital markings (Fig. 25b) small, numerous, arranged in pre- and postsetal rows on *xvii–xx*, lateral limits of rows slightly median to male pores.

Internal characters. Septa 5/6–12/13 slightly thickened. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs paired, large, extending to the dorsal line in *xi*, seminal vesicles in *xii*. Copulatory pouches confined to the body wall. Spermathecae (Fig. 15m) paired in *v–viii*.

DISTRIBUTION. North east New Guinea.

MATERIAL EXAMINED. 4C, 1A Top 15 cm of alluvial clay soil (derived from Gabbro), organic content 15–30% C/N ratio 8 or 9, gentle ridge with mixed montane forest with Podocarpus, Eleocarpaceae, Lauaceae, Cumoniaceae (dominant), Bismark range, East Highland district, Papua New Guinea, 2500 m, 5° 57' S, 145° 15' E, rainfall 900 cm/year, coll D R Kershaw 20 Jul 1971; BMNH 1975.5.167–171 (syntypes of *kershawae*). 2C Data as above, coll 14 Jul 1971; BMNH 1976.5.172–173. 1C Wau, North east New Guinea, 1200 m, coll J Sedlacher 13 Feb 1965; Honolulu.

Polypheretima coplandi sp. nov.

DIAGNOSTIC. *Polypheretima* with paired spermathecal pores about two fifths of the body circumference apart in furrows 4/5/6/7. Metandric.

DESCRIPTION. *External characters.* Length 70–92 mm; the four specimens are aclitellate, mature specimens may be considerably larger. Diameter c. 3 mm. C. 116 segments. Clitellum not recognizable. Dorsal pores not recognizable anterior to 19/20. Setae 36–38 on *vii*, 28–32 on *xx*, setal ring regular with ventral and dorsal gaps on preclitellar segments ($aa=1.5ab=1.5yz=zz$), dorsal and ventral gaps slightly larger on postclitellar segments ($aa=2ab=2yz=zz$).

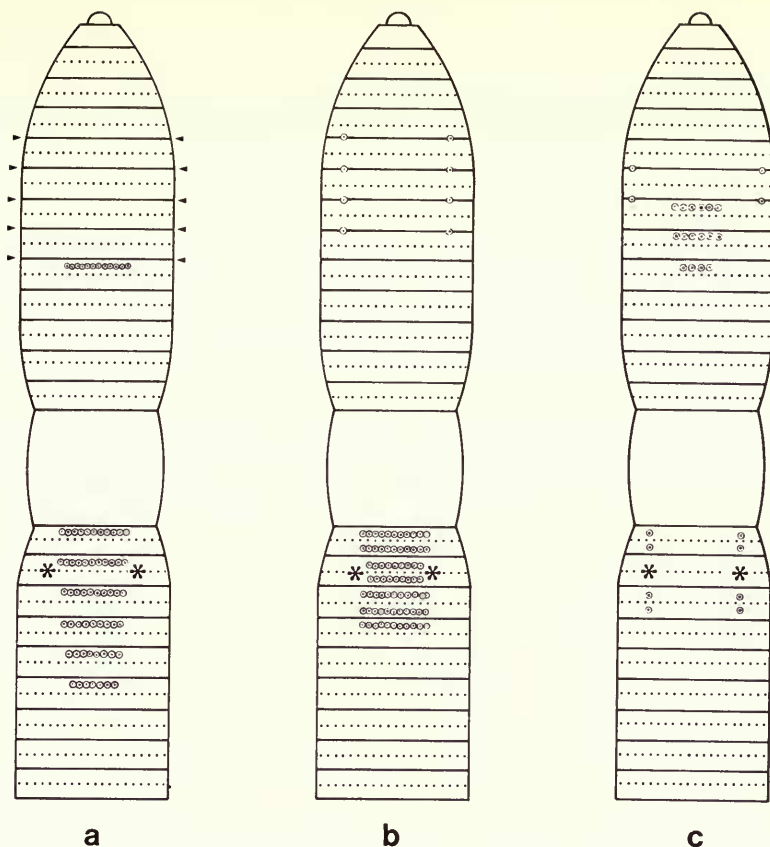


Fig. 25 Anterior ventral surface, diagnostic characters. (For ontogenetic variation of the male pores see Fig. 3.) (a) *Polypheretima patae* sp. nov.; (b) *P. kershawae* sp. nov.; (c) *P. huonensis* sp. nov.

Male pores on squat conical penes within copulatory pouches *c.* 0.19 body circumference apart. Female pores paired. Spermathecal pores paired, intersegmental in 4/5/6/7, *c.* 0.42 body circumference apart.

Genital markings not detected.

Internal characters. Septa 5/6–13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs paired but linked by a superoesophageal connection, in *xi*, seminal vesicles in *xii*, extending to the dorsal line. Pseudoseminal vesicles in *xiii*. Copulatory pouches confined to the body wall. Spermathecae (Fig. 15l) paired in *v–vii*.

DISTRIBUTION. North east New Guinea.

REMARKS. The four specimens on which this species is described lack genital markings. It is probable that mature individuals will possess markings of the type present in other members of the *patae*, species-group.

MATERIAL EXAMINED. 2A Bank of creek, D. A. S. F. Piggery, 3 miles from Goroka township, Eastern Highlands, Papua New Guinea, 6° 02' S, 145° 22' E, coll J W Copland; BMNH 1976.3.182–183 (syntypes of *coplandi*). 2A Data as above; BMNH 1977.1.213–214.

Polypheretima huonensis sp. nov.

DIAGNOSIS. *Polypheretima* with paired spermathecal pores about one third of the body circumference apart in furrows 5/6/7. Metandric. Genital markings numerous, presetal in transverse rows.

DESCRIPTION. *External characters.* Length *c.* 50 mm, diameter *c.* 3 mm. *C.* 96 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, *c.* 39 on *vii* and *xx*, setal ring with dorsal and ventral gaps on preclitellar segments ($aa = 2ab = 2yz = zz$).

Male pores on squat penes within copulatory pouches *c.* 0.20 body circumference apart. Female pores paired. Spermathecal pores paired, intersegmental in 5/6/7, *c.* 0.33 body circumference apart.

Genital markings (Fig. 25c), transverse rows of *c.* 4 small oval papillae, presetal on *vii-ix*, paired pre- and postsetal papillae on *xvii* and *xix* in line with the male pores.

Internal characters. Septa 5/6-13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs paired, extending to the dorsal line in *xi*, seminal vesicles extending to the dorsolateral line in *xii*. Pseudoseminal vesicles in *xiv*. Copulatory pouch small, restricted to the body wall, penes conical and short. Spermathecae (Fig. 15n) paired in *vi* and *vii*.

DISTRIBUTION. North east New Guinea.

MATERIAL EXAMINED. 1C Garden soil. Timbe valley, Huon Peninsula, Papua New Guinea, 1500 m, 6° 00' S, 147° 02' E, coll I L Owen, Aug 1976; BMNH 1977.21.1 (holotype of *huonensis*).

PLANAPHERETIMA Michaelsen, 1934

Megascolex (part): Vaillant, 1889 : 80.

Perichaeta (part): Beddard, 1895 : 388.

Amyntas (part): Beddard, 1900a : 612.

Pheretima (part): Michaelsen, 1900 : 234.

Pheretima (*Archipheretima*) (part) Michaelsen, 1928a : 7.

Pheretima (*Planapheretima*) Michaelsen, 1934b : 15.

Planapheretima: Sims & Easton, 1972 : 209, 233.

TYPE SPECIES. *Pheretima moultoni* Michaelsen, 1913, original designation.

DIAGNOSIS. Megascolecidae with an oesophageal gizzard in *viii*. Intestinal caeca sometimes present, intestinal walls often with glandular areas, intestinal gizzards absent. Body mainly flattened dorsoventrally, setae usually crowded ventrally, creeping sole often present. Male pores simple, never within copulatory pouches. Spermathecal diverticular simple, usually ectal in origin.

DESCRIPTION. Body cylindrical or flattened dorsoventrally, often with a glandular ventral surface (creeping sole) on the anterior region of the body. Clitellum annular, extending over three or more segments (*xiii*, *xiv-xvi*, *xvii*). First dorsal pore between 6/7 and 12/13. Setae perichaetine, evenly distributed round each segment or crowded, often densely, on the ventral surface. Lateral hearts in *x-xii* and sometimes *xiii*.

Oesophagus with a well-developed gizzard in *viii*; calciferous glands and dorsal pouches absent. Intestine begins in *xiv*, *xv* or *xvi*, often modified by the development of glandular walls or a pair of lateral caeca, intestinal gizzards absent. In the absence of externally recognizable adaptations to arboreal life, the presence of glandular intestinal walls may be used to recognize Chinese members of this genus.

Holandric. The testes of each segment are enclosed in single or paired stout sacs which usually occupy most of the coelom and often enclose the anterior seminal vesicles and the lateral hearts of *x* and *xi*. Seminal vesicles paired in *xi* and *xii*. Prostates racemose. Paired combined male and prostatic pores on the ventral surface of *xviii* in the setal ring. Male pores usually simple or on circular porophores, rarely on slim superficial penes (Fig. 29a), on penes carried on circular porophores (Fig. 3g) or on a raised area (Fig. 29b). Copulatory pouches absent. Ovaries free in *xiii*. Oviducts lead to single or closely paired, midventral, equatorial pore(s) on *xiv*. Spermathecae each differentiated into duct and ampulla; diverticula simple, usually ectal in origin and usually as long as or longer than the main duct and ampulla. Spermathecae arranged in pairs in one to five adjacent segments between *v* and *ix*. Spermathecal pores small or small slitlike openings, always intersegmental.

Genital markings of the discrete type or annular ridges; diffuse markings absent. Discrete genital markings may be single or paired, segmental or intersegmental, they are never random or

numerous (cf. *Polypheretima bifaria* and *patae* species-group). The glandular tissue associated with the genital markings is usually restricted to the body wall and only rarely invades the coelom in the form of a stalked gland. The area around the male pores may be infrequently elevated above the body surface.

DISTRIBUTION. (Fig. 7.) In areas of high humidity in China, Burma, Sumatra, Borneo, Celebes and New Guinea.

NUMERICAL STUDIES. The taxa of the genus *Planapheretima* listed in Table 1 (72–85) were subjected to a numerical analysis utilizing the characters listed in Table 2. The configuration of taxa with the first and third vectors of the principle co-ordinate analysis employed as axes produced the greatest degree of clustering. The use of the first and second vectors produced similar but more diffuse clusters. Recognition of the clusters is considerably enhanced by the addition of the MST with graded linkages (Fig. 26).

Two divisions, indicated by circular and square symbols, may be recognized. The taxa of Division I from the Indo-Australasian archipelago (indicated by circular symbols) all have simple intestines while those of Division II from Asia (square symbols) have intestines modified by the development of glandular walls and/or intestinal caeca.

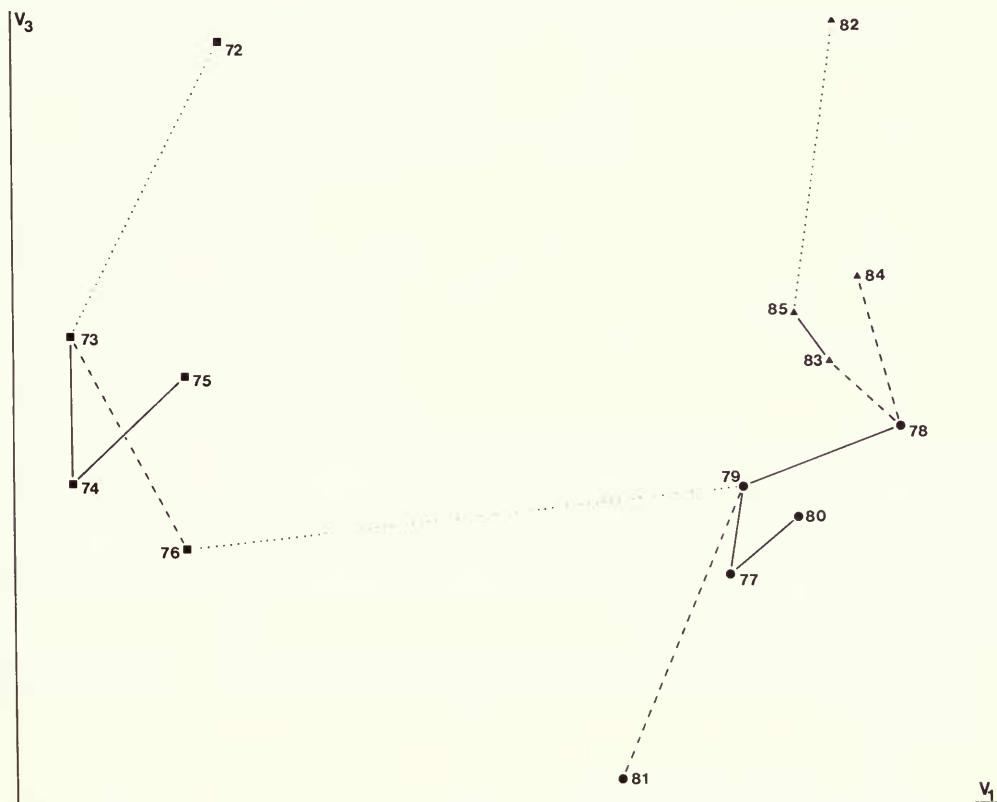


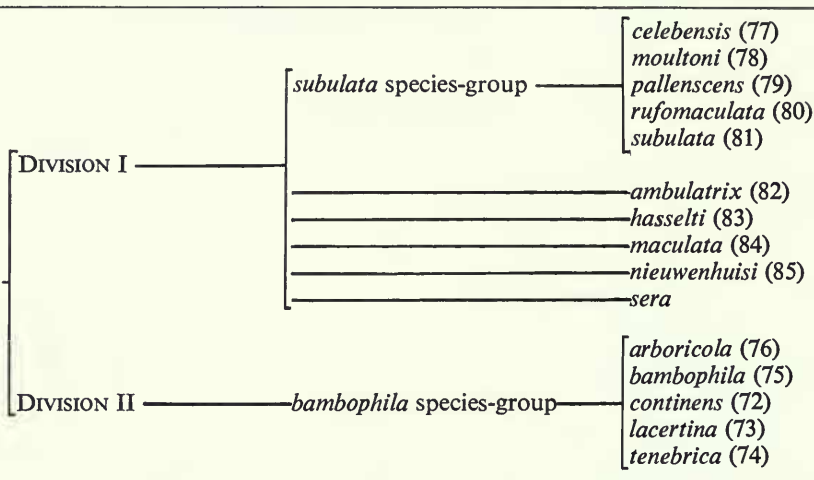
Fig. 26 Principal co-ordinates analysis of 14 species here assigned to *Planapheretima* (72–85 of Table 1): the configuration of species with the vectors corresponding to the first and third latent roots. The linkages of the added MST are graded to indicate percentage similarities; —, +90%; - - - -, 85–90%, ····, <85%. Two major assemblages are recognized: Division I – circular and triangular symbols (circles – *subulata* species-group, triangles – species allied to the *subulata* species-group). Division II – square symbols (*bambophila* species-group).

Division I contains five taxa (indicated by solid circular symbols), they are situated close together on the first and third vectors and possess relatively high mutual MST linkages. Morphologically these taxa are similar in having simple male pores on circular porophores and (when present) paired genital markings; all are assigned to the *subulata* species-group. The other four taxa of Division I (indicated by open circular symbols) have, with the exception of 83 and 85, lower MST linkages. Unlike the taxa of the *subulata* species-group, they exhibit considerable diversity in the form of the male pores and the genital markings. It is proposed to consider each as a separate species.

It has not been possible to examine any representatives of the taxa of Division II before the numerical studies were undertaken so assessments were derived from the original descriptions (Gates, 1972 : 169 in the case of *arboricola*). All are now assigned to the *continens* species-group.

A summary of the phenetic classification based on this numerical investigation is given in Table 10.

Table 10 Phenetic classification and checklist of the genus *Planapheretima*



Numbers in parentheses indicate taxa assessed in numerical studies (see Figs 6 and 26).

REMARKS. It is clear from the general numerical study (see above) that the acaecate and caecate species included in this genus form a single phenetic group, distinct from all of the other acaecate species assessed. However, in the absence of representatives of the caecate genera from these computations, no information is available about the affinities of the caecate members of *Planapheretima* with the caecate genera of the *Pheretima* group. Unfortunately the two representatives of *Planapheretima* which were included in the general appraisal of the *Pheretima* group by Sims & Easton (1972) were both acaecate.

In *P. moultoni* and *celebensis*, paired, intersegmental markings are closely associated with the male pores and superficially resemble the crescentic markings found in *Metapheretima* and *Pleionogaster*.

Key to the species of the genus *Planapheretima*

1	First spermathecal pores in furrow 4/5	.	.	.	.	.	.	.	.	2
	First spermathecal pores in furrow 5/6	.	.	.	.	.	.	.	.	5
	First spermathecal pores in furrow 6/7	.	.	.	.	.	.	.	.	8
	First spermathecal pores in furrow 7/8	.	.	.	.	.	.	.	.	10
2	Three thecal segments	.	.	.	.	.	.	.	.	3
	Five thecal segments	.	.	.	.	.	.	.	.	<i>subulata</i> (p. 69)
3	Intestinal caeca absent (Borneo)	.	.	.	.	.	.	.	.	4
	Intestinal caeca present (rudimentary) (China)	.	.	.	.	.	.	.	.	<i>continens</i> (part) (p. 75)

4	Spermathecae as Fig. 27a	.	.	.	.	.	.	<i>moultoni</i> (p. 68)
	Spermathecae as Fig. 27b	.	.	.	.	.	.	<i>pallescens</i> (p. 68)
5(1)	One thecal segment	.	.	.	.	.	.	<i>rufomaculata</i> (p. 71)
	Two thecal segments	.	.	.	.	.	.	<i>hasselti</i> (p. 71)
	Three thecal segments	.	.	.	.	.	.	<i>continens</i> (part) (p. 75)
	Four thecal segments	.	.	.	.	.	.	6
6	Intestinal caeca absent	.	.	.	.	.	.	7
	Intestinal caeca simple, rudimentary	.	.	.	.	.	.	<i>lacertina</i> (p. 77)
	Intestinal caeca multiple	.	.	.	.	.	.	<i>arboricola</i> (p. 76)
7	Spermathecal pores lateral; intestinal wall simple (Celebes)	.	.	.	.	.	.	<i>celebensis</i> (p. 70)
	Spermathecal pores ventrolateral; intestinal wall glandular in segments xx-xc (China)	.	.	.	.	.	.	<i>tenebrica</i> (p. 78)
8(1)	One thecal segment	.	.	.	.	.	.	9
	Two thecal segments	.	.	.	.	.	.	<i>ambulatrix</i> (p. 71)
9	Postclitellar genital field as Fig. 29c	.	.	.	.	.	.	<i>maculata</i> (p. 73)
	Postclitellar genital field as Fig. 30c	.	.	.	.	.	.	<i>sera</i> (p. 73)
10(1)	Males pores <i>c.</i> 0.15 body circumference apart; postclitellar genital markings (Fig. 29d)	.	.	.	.	.	.	<i>nieuwenhuisi</i> (p. 74)
	single, median presetal (Borneo)	.	.	.	.	.	.	<i>bambophila</i> (p. 78)
	Male pores <i>c.</i> 0.25 body circumference apart; postclitellar genital markings not of this form or absent (China)	.	.	.	.	.	.

Planapheretima subulata species-group

DIAGNOSIS. *Planapheretima* with simple intestines lacking glandular walls and caeca. Male pores on simple porophores, genital markings paired.

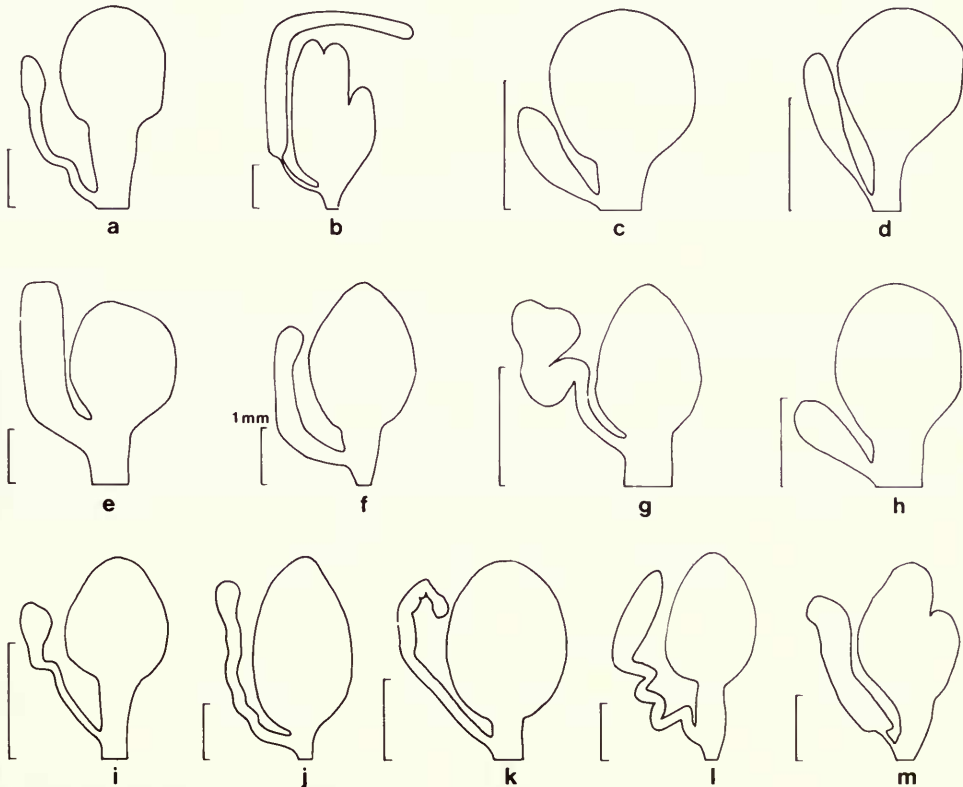


Fig. 27 Spermathecae. (a) *Planapheretima moultoni*; (b) *P. pallescens*; (c) *P. subulata*; (d) *P. celebensis*; (e) *P. ambulatrix*; (f) *P. hasselti*; (g) *P. maculata*; (h) *P. nieuwenhuisi*; (i) *P. continens*; (j) *P. arboricola*; (k) *P. lacertina*; (l) *P. tenebrica*; (m) *P. bambophila*. All scales 0.5 mm unless otherwise indicated. (See also Fig. 30f.)

DISTRIBUTION. Borneo, Celebes, New Guinea.

SPECIES INCLUDED. *celebensis*, *moultoni*, *pallescens*, *rufomaculata*, *subulata*.

REMARKS. Most of the species included within the *subulata* species-group are readily distinguishable on the distribution of their spermathecal pores; *subulata* 5 pairs 4/5/6/7/8/9, *celebensis* 4 pairs 5/6/7/8/9, *moultoni* and *pallescens* 3 pairs 4/5/6/7 and *rufomaculata* 1 pair 5/6. The affinities of *moultoni* and *pallescens* are discussed below (see remarks of *moultoni*).

Planapheretima moultoni (Michaelsen, 1913)

Pheretima moultoni Michaelsen, 1913b : 90; Michaelsen, 1914 : 59.

Pheretima (Archipheretima) moultoni: Michaelsen, 1928a : 14.

Pheretima (Planapheretima) moultoni: Michaelsen, 1934b : 15.

Planapheretima moultoni: Sims & Easton, 1972 : 209, 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrows 4/5/6/7. Spermathecae as Fig. 27a.

DESCRIPTION. *External characters.* Length 45–55 mm, diameter 2–2.5 mm 93–100 segments. Body depressed, concave ventrally, with creeping sole. Colouration; light yellowish grey with up to 20 small dark violet-brown or nearly black spots around each dorsal pore, the spots fusing to form a ring with the pore marked by a white spot, the rings fuse to form a median line which becomes larger posteriorly, the number of irregular spots diminish posteriorly as well. Clitellum $\frac{1}{2}$ xiii–xvi. First dorsal pore 9/10. Setae *c.* 100 on each segment, setal ring crowded ventrally without dorsal or ventral gaps ($5aa = 5ab = yz = zz$).

Male pores on slightly raised conical porophores *c.* 0.30 body circumference apart. Female pore single. Spermathecal pores small in 4/5/6/7, *c.* 0.33 body circumference apart.

Genital markings (Fig. 28a) paired, pre- and postsetal, slightly median to the male pores on xviii.

Internal characters. Anterior septa delicate, some in the region of the gizzard possibly absent. Intestine simple, begins in xv. Lateral hearts in x–xiii.

Holandric, testes sacs paired, large in x and xi, seminal vesicles small, extending to the lateral line in xi and xii. Spermathecae (Fig. 27a) paired in v–vii.

DISTRIBUTION. Borneo.

REMARKS. *P. moultoni* and *pallescens* may be distinguished only by the form of the spermathecae and the absence of genital markings in *pallescens*. Since the holotype of *pallescens* has been dissected nearly to destruction, it is difficult to assess the validity of these distinctions and possibly when more material becomes available for study, *pallescens* may prove to be a junior synonym of *moultoni*.

MATERIAL EXAMINED. 2C Mt Poi, Sarawak; Hamburg v8090 (syntypes of *moultoni*). 3C, 2A Mt Poi, Sarawak; Hamburg v10510 (*moultoni*: Michaelsen, 1928).

Planapheretima pallescens (Michaelsen, 1928)

Pheretima (Archipheretima) pallescens Michaelsen, 1928a : 15.

Pheretima (Planapheretima) pallescens: Michaelsen, 1934b : 15.

Planapheretima pallescens: Sims & Easton, 1972 : 231.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrows 4/5/6/7. Spermathecae as Fig. 27b.

DESCRIPTION. *External characters.* Length *c.* 60 mm (aclitellate), diameter *c.* 2.2 mm. *C.* 96 segments. Body depressed ventrally, creeping sole on xvi–xx. Colouration; bright yellow with a reddish, mother of pearl lustre and a sparsely developed brown, irregularly defined line on the anterior segments of the body. Clitellum not developed. First dorsal pore at either 10/11 or 11/12. Setae, *c.* 122 on v, *c.* 141 on ix, *c.* 134 on xvii.

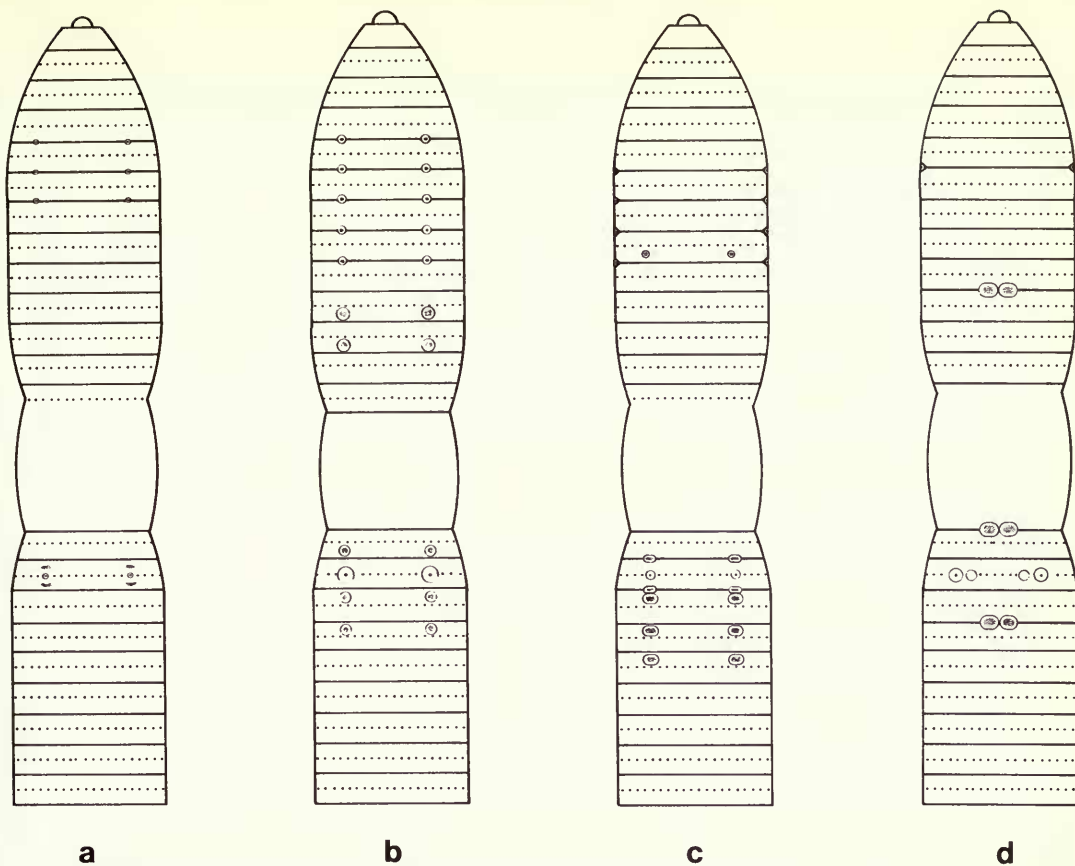


Fig. 28 Anterior ventral surface, diagnostic characters. (a) *Planapheretima moultoni*; (b) *P. subulata*; (c) *P. celebensis*; (d) *P. rufomaculata*.

Male pores on small porophores outside the region of the creeping sole, $c. 0.33$ body circumference apart. Female pore(s) not recorded. Spermathecal pores in 4/5/6/7, $c. 0.33$ body circumference apart.

Genital markings not detectable.

Internal characters. Anterior septa delicate, 8/9/10 not detected and probably absent. Beginning of intestine not recorded. Intestine simple. Disposition of lateral hearts not recorded.

Holandric, testes sacs large, paired in x and xi , seminal vesicles small in xi and xii . Spermathecae (Fig. 27b), paired in $v-vii$.

Description after Michaelsen (1928); and the author after examination of the remains of the holotype.

DISTRIBUTION. Borneo.

REMARKS. This species is similar to *moultoni* with which it may be conspecific (see above).

MATERIAL EXAMINED. 4 spermathecae, gizzard, oesophagus, part of anterior intestine and anterior male reproductive system, Mt Penrissen, Sarawak; Hamburg v10522 (remains of holotype of *pallescens*).

Planapheretima subulata (Michaelsen, 1899)

Amyntas subulatus Michaelsen, 1899 : 29; Beddard, 1900a : 641.

Pheretima subulata: Michaelsen, 1900 : 307.

Metapheretima subulata: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrows 4/5/6/7/8/9.

DESCRIPTION. *External characters.* Length 60–70 mm, diameter *c.* 3 mm. 105–106 segments. Body flattened, concave ventrally, creeping sole poorly developed. Colouration; (preserved specimen), brownish dorsally, light yellowish white ventrally, clitellum yellowish grey. Clitellum *xiv–xvi*. First dorsal pore 6/7. Setae, *c.* 80 on *vii*, *c.* 60 on *xx*, setal ring crowded ventrally with dorsal gaps on preclitellar segments ($4aa=4ab=yz=0.5zz$), without dorsal or ventral gaps on postclitellar segments ($4aa=4ab=yz=zz$).

Male pores at the centre of large circular porophores *c.* 0.30 body circumference apart. Female pores paired. Spermathecal pores large in furrows 4/5/6/7/8/9, *c.* 0.30 body circumference apart.

Genital markings (Fig. 28b) paired, in line with the male pores, presetal on *xix* and *xx*, postsetal on *x*, *xi* and *xvii*.

Internal characters. Anterior septa present and delicate. Intestine simple, begins in *xvi*. Lateral hearts in *x–xii*.

Holandric, testes sacs large, paired, extending to the dorsal line, in *x* and *xi*, seminal vesicles large, extending to the dorsal line in *xi* and *xii*. Spermathecae (Fig. 27c), paired in *v–ix*.

DISTRIBUTION. Celebes.

REMARKS. Sims & Easton (1972) placed this species in *Metapheretima* on the basis of its original description but the subsequent examination of the type series revealed the depressed body, crowded ventral setae and creeping sole which characterize the genus *Planapheretima*.

MATERIAL EXAMINED. 1C Central Celebes; Hamburg v5192 (syntypes of *subulata*). 2C 1A Central Celebes; Hamburg v5193 (syntypes of *subulata*).

The original description of this species was based on two series of specimens, both collected by P. & U. Sarasin in February 1895 from central Celebes. The localities were: Hill country in the region of the Kalaena river, *c.* 400 m, 5 Feb 1895 and southern foothills of Takalekadjo, *c.* 1000 m, 7 Feb 1895. Although the labels clearly indicate that these specimens were collected in central Celebes by P. and M. Sarasin, they do not indicate from which locality each series originated.

Planapheretima celebensis (Michaelsen, 1899)

Amyntas celebensis Michaelsen, 1899 : 32; Beddard, 1900a : 642.

Pheretima celebensis : Michaelsen, 1900 : 261.

Planapheretima celebensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with simple intestine; spermathecal pores in furrows 5/6/7/8/9.

DESCRIPTION. *External characters.* Length *c.* 60 mm, diameter *c.* 2 mm, *C.* 90 segments. Shape of body and form of ventral surface not recorded. Colouration; (preserved specimen) bright brownish yellow dorsally, grey ventrally, clitellum dark violet grey. Clitellum $\frac{2}{3}xiii–xvi$. First dorsal pore 6/7. Setae, *c.* 49 on *vi*, *c.* 48 on *x*, *c.* 40 on *xvii*, *c.* 44 on *xxvi*, setal ring crowded ventrally ($3ab=yz$).

Male pores on oval porophores *c.* 0.29 body circumference apart. Female pore(s) not recorded. Spermathecal pores in furrows 5/6/7/8/9, *c.* 0.50 body circumference apart.

Genital markings (Fig. 28c) paired, in line with the male pores, presetal on *xix–xxi*, postsetal on *viii*, intersegmental at 17/18, 18/19.

Internal characters. Anterior septa present and delicate. Beginning of intestine not recorded. Intestine simple. Lateral hearts in *x–xiii*.

Holandric, testes sacs paired, large in *x* and *xi*, seminal vesicles in *xi* and *xii*. Spermathecae (Fig. 27d) paired in *vi–ix*.

Description based on Michaelsen, 1899, 1900; Fig. 28c is an interpretation of the genital field based on the written description.

DISTRIBUTION. Celebes.

RECORDS. 1C Takalekadjo range, central Celebes; Hamburg v5188 (holotype of *celebensis*). Although this specimen is listed in the catalogue of the Hamburg Museum it could not be located during the preparation of this paper: Dr M. Dzwillo, personal communication.

Planapheretima rufomaculata (Gates, 1948)

Planapheretima rufomaculata Gates, 1948 : 162.

Planapheretima rufomaculata: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrow 5/6 only.

DESCRIPTION. *External characters.* Length 43–45 mm, diameter *c.* 4 mm. Segment number not recorded. Body depressed, creeping sole not recognized. Colouration; pigmentation restricted to three longitudinal, irregular stripes, a median dorsal dark red stripe and two lateral light red stripes. Clitellum $\frac{1}{3}$ xiii–xvi. First dorsal pore 11/12. Setal numbers not recorded, setal ring crowded ventrally.

Male pores on circular, widely spaced, porophores separated by 25–26 setae. Female pore single. Spermathecal pores in 5/6, *c.* 0.50 body circumference apart.

Genital markings (Fig. 28d) closely paired, intersegmental at 9/10, 16/17 and 19/20, segmental, slightly median to male pores on xviii.

Internal characters. Anterior septa present and delicate. Intestine simple, begins in xv. Lateral hearts in ix–xiii.

Holandric, testes sacs single, U-shaped, extending to the dorsal line in x, those of xi not seen but assumed to be similar, seminal vesicles in xi and xii, details not recorded. Spermathecae, paired in vi, duct as long as main ampulla, diverticulum ental, tubular, nearly as long as main axis.

Stalked glands associated with the genital markings.

Description after Gates, 1948; Fig. 28d is an interpretation of the genital field based on the written description.

DISTRIBUTION. New Guinea.

RECORDS. 2C Near Idenburg river, West Irian (holotype and paratype of *rufomaculata*). The type series of this species is absent from the collections of the Museum Zoologicum Bogoriense where Reynolds & Cook (1976) stated it had been deposited: Dr S. Kadarsan, personal communication.

Planapheretima ambulatrix (Michaelsen, 1934)

Pheretima (*Planapheretima*) *ambulatrix* Michaelsen, 1934b : 22.

Planapheretima ambulatrix: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrows 6/7/8.

DESCRIPTION. *External characters.* Length *c.* 55 mm, diameter *c.* 2.5 mm. *C.* 100 segments. Body depressed with a creeping sole occupying the whole ventral surface. Colouration; (preserved specimen) yellowish to yellowish grey without pigmentation. Clitellum $\frac{1}{2}$ xiii–xvii. First dorsal pore not recognized. Setae, *c.* 120 on vii, *c.* 130 on xx, setal ring crowded ventrally without dorsal or ventral gaps ($5aa = 5ab = yz = zz$).

Male pores on minute elongate penes *c.* 0.25 body circumference apart (Fig. 29a). Female pore(s) not recognized. Spermathecal pores small in 6/7/8, *c.* 0.25 body circumference apart.

Genital markings not recognized.

Internal characters. Anterior septa present and delicate. Intestine simple, begins in xvi. Lateral hearts in x–xii.

Holandric, testes sacs simple, U-shaped and large in x and xi, seminal vesicles extending to the dorsal line in xi and xii. Spermathecae (Fig. 27e) paired in vii and viii.

DISTRIBUTION. Borneo.

MATERIAL EXAMINED. 1C 5A Mt Dulit, Sarawak; BMNH 1933.10.6.6 (holotype and paratypes of *ambulatrix*). 2A Data as above; Hamburg v11955 (paratypes of *ambulatrix*).

Planapheretima hasselti (Horst, 1883)

Megascolex hasselti Horst, 1883 : 190; Vaillant, 1889 : 80.

Perichaeta hasselti: Horst, 1885 : 5; Beddard, 1895 : 426.

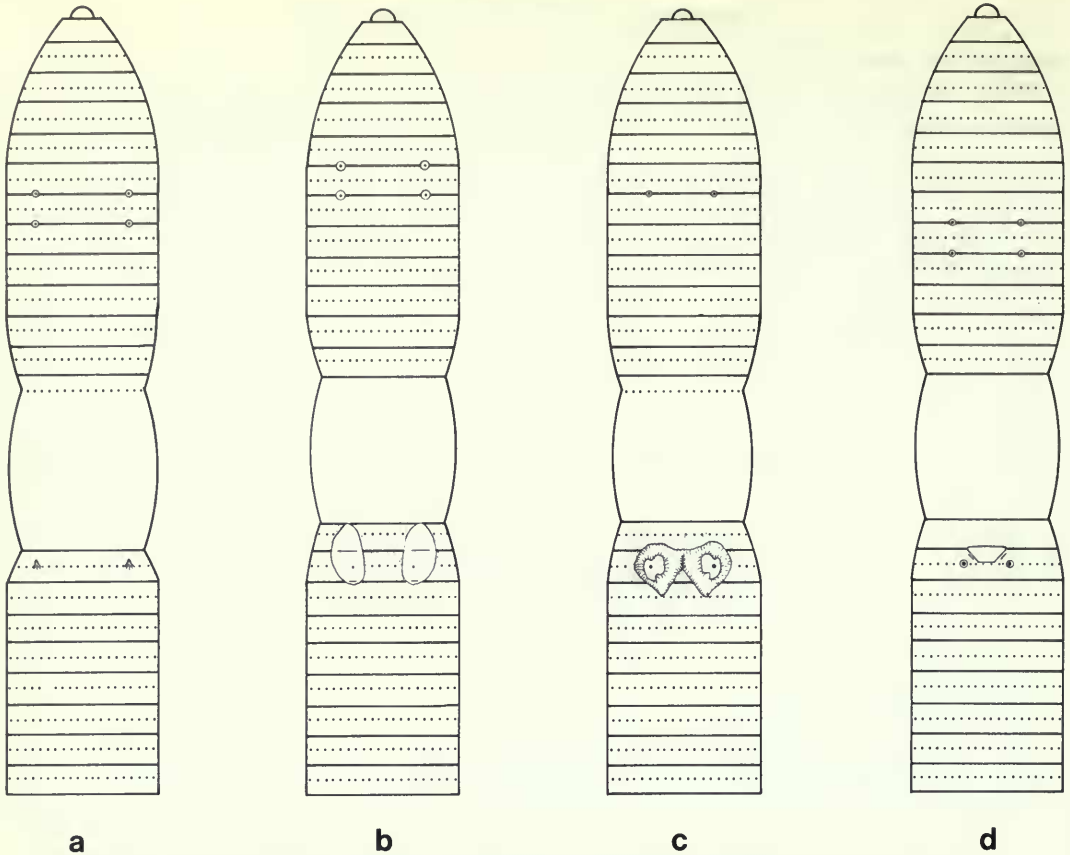


Fig. 29 Anterior ventral surface, diagnostic characters. (a) *Planapheretima ambulatrix*; (b) *P. hasselti*; (c) *P. maculata*; (d) *P. nieuwenhuisi*.

Amyntas hasselti: Beddard, 1900a : 638.

Pheretima hasselti: Michaelsen, 1900 : 271 [non Michaelsen, 1922 : 30 (= *Amyntas morrissi* species-group)].

Planapheretima hasselti: Sims & Easton, 1972 : 180, 233.

Pheretima (Planapheretima) frondicola Michaelsen, 1934b : 17.

Planapheretima frondicola: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrows 5/6/7.

DESCRIPTION. *External characters*. Length 50–54 mm, diameter 2–3 mm. 90–95 segments. Body depressed with a creeping sole occupying the ventral surface. Colouration; (preserved specimen), pale yellowish grey or grey with lighter intersegmental furrows. Clitellum *xiii*–*xvi*. First dorsal pore 12/13. Setae, *c.* 110 on *vii*, *c.* 70 on *xx*, setal ring crowded ventrally without dorsal or ventral gaps ($6aa = 6ab = yz = zz$).

Male pores simple, *c.* 0.13 body circumference apart on large, oval porophores extending onto *xvii* and *xix* (Fig. 29b). Female pore single. Spermathecal pores large in 5/6/7, *c.* 0.22 body circumference apart.

Genital markings absent.

Internal characters. Anterior septa present and delicate. Intestine simple, begins in *xv*. Lateral hearts in *x*–*xiii*.

Holandric, testes sacs paired, large, extending to the dorsal line in *x* and *xi*, seminal vesicles of *xi* small, extending to the lateral line, those of *xii* larger, extending to the dorsal line. Spermathecae (Fig. 27f) paired in *vi* and *vii*,

DISTRIBUTION. Sumatra and Borneo.

REMARKS. The material identified as *hasselti* by Michaelsen (1922) is here assigned to the *Amyntas morrissi* species-group since it lacks a depressed body, has crowded ventral setae and paired intestinal caeca—confirmed by examination of Michaelsen's material: Leiden, 1854.

The species *frondicola* has been included within the synonymy of *hasselti* since the two type series differ from each other only in that the clitellum is longer and the raised areas bearing the male pores are more fully developed in *frondicola*.

This is the only representative of *Planapheretima* recorded from Sumatra.

MATERIAL EXAMINED. 2C Lebang, Sumatra; Leiden 1853 (holotype of *hasselti*). 1C, 1A Mt Dulit, Sarawak; BMNH 1933.10.6.9 (syntypes of *frondicola*). 2A Locality as above; Hamburg v11957 (syntypes of *frondicola*).

Planapheretima sera sp. nov.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrow 6/7 only. Male pores on elongate porophores (Fig. 30c).

DESCRIPTION. *External characters.* Length *c.* 78 mm, diameter *c.* 3 mm. C. 115 segments. Body depressed, creeping sole present on postclitellar segments. Colouration; yellowish brown with dark brown or red spots on dorsal and lateral surfaces, clitellum purple. Clitellum $\frac{3}{4}$ xiii–xvi. First dorsal pore 8/9 or 9/10. Setae *c.* 70 on *vii* and *xx*, setal ring crowded ventrally without dorsal or ventral gaps (*Saa* = *Sab* = *yz* = *zz*).

Male pores postsetal on large oval posteriorly directed porophores which occupy the whole length of the segment, *c.* 0.20 body circumference apart. Female pore(s) not seen. Spermathecal pores small in 6/7, *c.* 0.40 body circumference apart.

Genital markings (Fig. 30c) paired, presetal, in line with the male pores on *xix* and *xx*.

Internal characters. Anterior septa present and delicate. Intestine simple, begins in *xv*. Lateral hearts in *x–xiii*.

Holandric, testes sacs single, U-shaped, extending to the dorsolateral line in *x* and *xi*, seminal vesicles in *xi* and *xii*, those of *xi* enclosed in the testes sacs. Spermathecae (Fig. 30f) paired in *vii*, diverticulum very long, convoluted.

DISTRIBUTION. Borneo.

MATERIAL EXAMINED. 1C On ivy-like leaf of 20 m tall shrub, near old campsite, Royal Geographical Society camp 4, ridge top forest, Gunong Mulu, Sarawak, altitude 1970 m, 4° 02'N, 114° 54' E, coll J Dring 2030 hrs, 22 Aug 1977; BMNH 1977.21.2 (holotype of *sera*). 1C On leaf of herb, 1 m up bank of dried up temporary stream, Royal Geographical Society camp 3, Gunong Mulu, Sarawak, altitude 1450 m, coll J Dring 2100 hrs, 9 Sep 1977; BMNH 1977.212 (paratype of *sera*).

Planapheretima maculata (Ude, 1925)

Pheretima maculata Ude, 1925 : 104.

Pheretima (Archipheretima) maculata: Michaelsen, 1928a : 18; Ude, 1932 : 120.

Pheretima (Planapheretima) maculata: Michaelsen, 1934b : 15.

Planapheretima maculata: Sims & Easton, 1972 : 233.

Pheretima (Archipheretima) scandens Michaelsen, 1928a : 18.

Pheretima (Planapheretima) scandens: Michaelsen, 1934b : 15.

Planapheretima scandens: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrow 6/7 only. Male pores surrounded by annular ridges (Fig. 29c).

DESCRIPTION. *External characters.* Length 30–40 mm, diameter 2–3 mm. 50–77 segments. Body depressed with creeping sole on the ventral surface. Colouration; whole body highly iridescent, yellowish brown with, on the dorsal surface, irregularly arranged rust-red or dark brown spots

which form a ring-shaped pattern around each dorsal pore, clitellum violet brown. Clitellum $\frac{1}{3}$ *xiii-xvi*. First dorsal pore 9/10 or 10/11. Setae, 40-59 on *vii* and *xx*, setal ring crowded ventrally without dorsal or ventral gaps ($5aa = 5ab = yz = zz$).

Male pores simple, *c.* 0.33 body circumference apart. Female pore single. Spermathecal pores small in 6/7, *c.* 0.33 body circumference apart.

Genital markings (Fig. 29c) in the form of a ridge surrounding each male pore.

Internal characters. Anterior septa delicate, 8/9 absent. Intestine simple, begins in *xv*. Lateral hearts in *xi-xiii* and possibly *x*.

Holandric, testes sacs paired, large in *x* and *xi*; seminal vesicles in *xi* and *xii*, those of *xi* enclosed in the testes sacs of that segment. Spermathecae (Fig. 27g) paired in *vii*.

DISTRIBUTION. Borneo.

REMARKS. The type series of *scandens* differs from the original description of *maculata* in the form of the spermathecal diverticulum, this difference is considered insufficient to justify the separation of two forms.

MATERIAL EXAMINED. 1C Mt Penrissen, Sarawak; Hamburg v10515 (holotype of *scandens*).

OTHER RECORDS. Mt Murud, Brunei; (type(s) of *maculata*).

Planapheretima nieuwenhuisi (Michaelsen, 1922)

Pheretima nieuwenhuisi Michaelsen, 1922 : 47.

Pheretima (*Archipheretima*) *nieuwenhuisi*: Michaelsen, 1928a : 22.

Pheretima (*Planapheretima*) *nieuwenhuisi*: Michaelsen, 1934b : 15.

Planapheretima nieuwenhuisi: Sims & Easton, 1972 : 181, 233.

DIAGNOSIS. *Planapheretima* with a simple intestine; spermathecal pores in furrows 7/8/9.

DESCRIPTION. *External characters.* Length *c.* 44 mm, diameter *c.* 2 mm. C. 92 segments. Body depressed with a distinct creeping sole. Colouration; body an intense chestnut brown or maroon becoming more greyish at the anterior and posterior ends, clitellum a bright bluish slate-grey. Clitellum *xiii-xvi*. First dorsal pore 9/10. Setae, *c.* 75 on *vii* and *xx*. Setal ring crowded ventrally without dorsal or ventral gaps ($5aa = 5ab = yz = zz$).

Male pores simple, *c.* 0.15 body circumference apart. Female pore single. Spermathecal pores small in 7/8/9, *c.* 0.20 body circumference apart.

Genital markings (Fig. 29d) single, median, intersegmental at 17/18.

Internal characters. Anterior septa present and delicate. Intestine simple, begins in *xiv*. Lateral hearts in *x-xiii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles of *xi* small, enclosed in the testes sacs of that segment, those of *xii* larger, extending to the dorsal line. Spermathecae (Fig. 27h) paired in *viii* and *ix*.

DISTRIBUTION. Borneo.

MATERIAL EXAMINED. 1C (lacking most of the internal anterior anatomy and parts of the body wall), Mt Damoes, 'Borneo' (? Kalimantan); Leiden 1811 (part of holotype of *nieuwenhuisi*). Gizzard, oesophagus, anterior portion of intestine, anterior male reproductive system and two fragments of body wall, data as above; Hamburg v9306 (part of holotype of *nieuwenhuisi*).

Planapheretima bambophila species-group

DIAGNOSIS. *Planapheretima* with an intestine modified in the anterior region by the presence of caeca or glandular walls or both.

DISTRIBUTION. Burma, China.

SPECIES INCLUDED. *arboricola*, *bambophila*, *continens*, *lacertina*, *tenebrica*.

REMARKS. The members of this species-group have caeca and/or glandular areas on the walls of the intestine; all occur on the mainland of Asia. In contrast, species outside of this species-group

(*P. subulata* species-group and its allies) have unmodified intestines and occur in the Indo-Australasian Archipelago.

As discussed above (see numerical studies) the five species comprising this species-group appear to be closely related although there are both caecate and acaecate forms from edaphic and arboricolous habitats. Despite the five species having apparently only convergent features in common with the other members of the genus, the generic diagnosis of *Planapheretima* has been widened to accommodate them, since I do not propose to elevate the group to generic status on current evidence. More morphological information is required while the genus *Amyntas*, with which this group seemingly has affinities, needs to be thoroughly revised.

In addition to the species included in the *bambophila* species-group, two others, *acidophila* and *jaoi*, have been recorded from arboricolous habitats in Szechwan. As neither is adapted morphologically to an arboreal mode of life nor is either apparently related to any of the species of the *bambophila* species-group, it is proposed that they should remain in *Amyntas* where they were placed by Sims & Easton (1972).

Knowledge of the Chinese members of the *bambophila* species-group derives from the original descriptions of the species (Chen, 1946). Several discrepancies in the separation of the male and spermathecal pores exist in these accounts so caution needs to be taken when identifying species of this group.

Marker characters of the species assigned to the *bambophila* species-group are given in Table 11.

Table 11 Marker characters of the members of the *Planapheretima bambophila* species-group

Species	Spermathecal furrows	Intestinal caeca	Distribution
<i>continens</i>	4/5/6/7 or 5/6/7/8	rudimentary	Szechwan
<i>lacertina</i>	5/6/7/8/9	rudimentary	Szechwan
<i>arboricola</i>	5/6/7/8/9	multiple	Burma
<i>tenebrica</i>	5/6/7/8/9	absent	Szechwan
<i>bambophila</i>	7/8/9	absent	Szechwan

Planapheretima continens (Chen, 1946)

Pheretima continens Chen, 1946 : 95.

Amyntas continens: Sims & Easton, 1972 : 235.

DIAGNOSIS. *Planapheretima* with rudimentary intestinal caeca; spermathecal pores in furrows 4/5/6/7 or 5/6/7/8.

DESCRIPTION. *External characters.* Length 33–38 mm, diameter *c.* 2 mm. 94–102 segments. Body cylindrical, creeping sole absent. Colouration; grey on dorsal surface, pale ventrally, clitellum light chocolate red. Clitellum $\frac{1}{2}$ xiii–xvii. First dorsal pore 11/12. Setae, 30–40 on *iii*, 54–58 on *vii*, 52–55 on *xxv*, setal ring slightly crowded ventrally with slight dorsal and ventral gaps ($aa = 1.2ab = 1.5yz = zz$).

Male pores on small penes which arise from circular porophores *c.* 0.33 body circumference apart. Female pore(s) not recorded. Spermathecal pores small in 5/6/7/8 or occasionally 4/5/6/7, *c.* 0.40 body circumference apart.

Genital markings (Fig. 30*b*) paired, presetal on *ix* slightly median to the line of the spermathecal pores.

Internal characters. Septa 5/6–7/8 thickened, 8/9/10 absent, 10/11 membranous, 11/12–14/15 thickened. Intestine begins in *xvi* with paired rudimentary caeca about one segment long (origin not recorded) and with glandular walls posterioriad to the caeca. Disposition of lateral hearts not recorded.

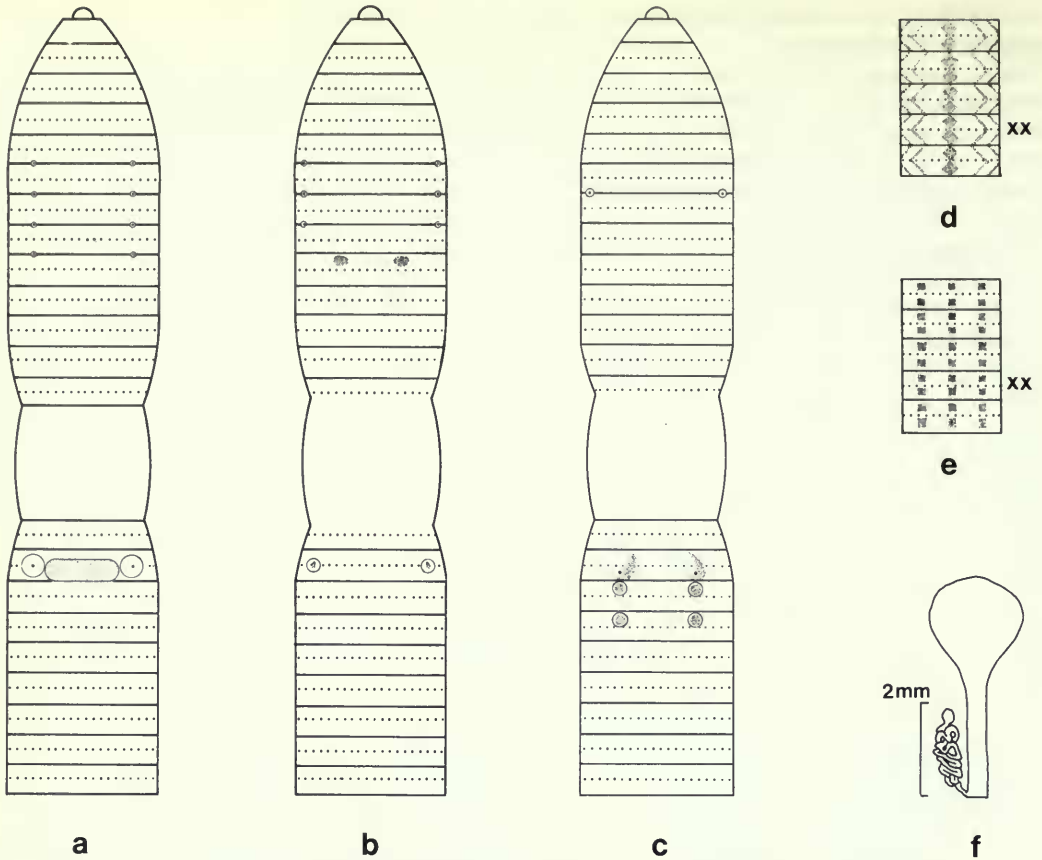


Fig. 30 Anterior ventral surface, diagnostic characters. (a) *Planapheretima arboricola*; (b) *P. continens*; (c) *P. sera* sp. nov. Dorsal pigmentation. (d) *P. lacertina*; (e) *P. tenebrica*. Spermatheca. (f) *P. sera* sp. nov.

Holandric, testes sacs paired, those of *x* extending to the dorsal line, those of *xi* smaller, seminal vesicles small in *xi* and *xii*. Spermathecae (Fig. 27i) paired in *vi-viii* or occasionally *v-vii*.

Description after Chen (1946).

DISTRIBUTION. Szechwan, China.

RECORDS. 2 specimens Mt Omei, Szechwan, China (types of *continens*). 2 specimens under moss, Changking, Szechwan, China (*continens*: Chen, 1946).

Planapheretima arboricola (Rosa, 1890)

Perionyx arboricola Rosa, 1890 : 119; Beddard, 1895 : 438; Michaelsen, 1900 : 209; Michaelsen, 1903b : 89; Stephenson, 1923 : 326; Gates, 1936a : 465; Gates, 1961 : 57; Gates, 1972a : 141.

Pheretima arboricola Gates, 1936a : 399; Gates, 1972a : 169.

Planapheretima arboricola: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with multiple intestinal caeca; spermathecal pores in furrows 5/6/7/8/9.

DESCRIPTION. *External characters*. Length *c.* 70 mm, diameter *c.* 5 mm. *C.* 110 segments. Body depressed, creeping sole on postclitellar segments becoming narrower posteriorly. Colouration; dark green or reddish dorsally, pale yellow ventrally, clitellum violet grey. Clitellum *xiv-xvi*. First dorsal pore ? 5/6 or 11/12. Setae *c.* 72 on *vii*, *c.* 60 on *xx*. Setal ring crowded ventrally, *7ab=yz*.

Male pores on large hemispherical porophores *c.* 0.18 body circumference apart. Female pore single. Spermathecal pores small paired, intersegmental in 5/6/7/8/9, *c.* 0.26 body circumference apart.

Genital markings (Fig. 30a) single, median, *xviii*.

Internal characters. Anterior septa delicate, 8/9/10 absent. Intestine begins in *xv* with paired, lateral multiple caeca originating in *xxvii*, details of intestinal wall not recorded. Lateral hearts in *x-xiii*.

Holandric, testes sacs single, ventral in *x* and *xi*, seminal vesicles large in *xi* and *xii*. Spermathecae (Fig. 27j) paired in *vi-ix*.

Fig. 30a is an interpretation of the genital field based on the written description of Gates (1936). The holotype lacks genital markings.

DISTRIBUTION. Burma.

REMARKS. The holotype of *Pheretima arboricola* Gates (1936) was recorded as being in the Museo Civico di Storia Naturale 'Giacomo Doria', Genoa (Reynolds & Cook, 1976). However, the specimen (44017) proved to be the holotype of *Perionyx arboricola* Rosa (1890) which had originally been reported as having a gizzard in *v* and a holonephric excretory system. On re-examination it was found that Rosa's description was inaccurate since the gizzard is in *viii* and the excretory system is micronephric, characters of the *Pheretima* group. Unfortunately the intestine was poorly preserved so preventing the recognition of any intestinal structures important for specific diagnosis within *Planapheretima*. It is assumed that caeca were once present in the holotype since Gates (1936) described an otherwise identical earthworm, destroyed in Burma between 1942 and 1945, which possessed these structures. [The paratype of *Perionyx arboricola*, Berlin 2270 (Reynolds & Cook, 1976 : 71) is a juvenile *Perionyx* of uncertain specific identity.]

MATERIAL EXAMINED. 1C Lacking anterior intestine and most of oesophagus, on trees, especially in the axils of leaves, Cobapo, Mt Carin, Cheba or Biapo district, Burma, coll L Fea; Genoa 44017 (holotype of *arboricola* Rosa, 1890).

OTHER RECORDS. 1C Toungoo district, Burma (holotype of *arboricola* Gates, 1936).

Planapheretima lacertina (Chen, 1946)

Pheretima lacertina Chen, 1946 : 109.

Planapheretima Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with rudimentary caeca; spermathecal pores in furrows 5/6/7/8/9.

DESCRIPTION. *External characters.* Length *c.* 81–82 mm, diameter 4–4.5 mm. 90–100 segments. Body depressed and concave ventrally, creeping sole not recorded. Colouration; dark chestnut or brownish black pattern (Fig. 30d) on a bluish background. Clitellum *xiv-xvi*. First dorsal pore 10/11. Setae, *c.* 72 on *iii*, *c.* 78 on *vi*, *c.* 81 on *ix*, *c.* 72 on *xxv*, setal ring crowded ventrally (3–4*ab*=*yz*) dorsal and ventral gaps not recorded.

Male pores in large glandular, circular depressions *c.* 0.33 body circumference apart. Female pore(s) not recorded. Spermathecal pores small in 5/6/7/8, separation uncertain [either 0.33 or 0.44 body circumference apart (see remarks under *bambophila* species-group)].

Genital markings, none recorded.

Internal characters. All anterior septa present and delicate except for 6/7–8/9 which are slightly thickened. Intestine begins in *xv* with paired rudimentary lateral caeca restricted to *xxvi*, intestinal wall posterioriad to caeca glandular. Disposition of lateral hearts not recorded.

Holandric, testes sacs single in *x* and *xi*, seminal vesicles large in *xi*, those of *xii* extending posteriorly to *xiv*. Spermathecae (Fig. 27k) paired in *vi-ix*.

Description after Chen (1946).

DISTRIBUTION. Szechwan, China.

RECORDS. 2 specimens, among moss on bark of trees, Mt King-Fu, Szechwan, China, 2000 ft (types of *lacertina*).

Planapheretima tenebrica (Chen, 1946)

Pheretima tenebrica Chen, 1946 : 93.

Planapheretima tenebrica: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with an intestine lacking caeca but with thickened walls in *xxvi-xxxvi*; spermathecal pores in furrows 5/6/7/8/9.

DESCRIPTION. *External characters*. Length 35–60 mm, diameter 2–2.8 mm. *C.* 82 segments. Shape of body and creeping sole not recorded. Colouration; three longitudinal reddish brown dorsal stripes (Fig. 30e) on a chocolate-coloured background, clitellum dark chocolate to brick red. Clitellum *xiv-xvi*, encroaching onto *xiii* and *xvii*. First dorsal pore 9/10. Setae, 46–50 on *iii*, 52–60 on *ix*, 50–52 on *xix* and *xxv*, setal ring crowded ventrally with dorsal and slight ventral gaps (*aa* = 1–1.1*ab*; *zz* = 2–2.5*yz*).

Male pores on circular porophores, separation uncertain [either 0.20 or 0.33 body circumference apart (see remarks under *bambophila* species-group)]. Female pore(s) not recorded. Spermathecal pores small in 5/6/7/8/9, separation uncertain (either 0.20 or 0.33 body circumference apart).

Genital markings, none recorded.

Internal characters. All anterior septa present and delicate. Intestine begins in *xv*, caeca absent, intestinal walls of *xxvi-xxxvi* thickened. Disposition of lateral hearts not recorded.

Holandric, testes sacs of *x* paired but meeting ventrally, that of *xi* single ventral, seminal vesicles large in *xi* and *xii* extending posteriorly 5–7 segments. Spermathecae (Fig. 27l) paired in *vi-ix*.

Description after Chen (1946).

DISTRIBUTION. Szechwan, China.

RECORDS. 9 specimens, Mt Omei, Szechwan, China, 5000 ft (holotype and paratypes of *tenebrica*); 1 specimen in sandy ground under stone near creek, Nan-Chuan-Hsein, Szechwan, China (paratype of *tenebrica*).

Planapheretima bambophila (Chen, 1946)

Pheretima bambophila Chen, 1946 : 86.

Planapheretima bambophila: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Planapheretima* with an intestine lacking caeca but with thickened walls in *xxii-xxxviii*; spermathecal pores in furrows 7/8/9.

DESCRIPTION. *External characters*. Length 40–55 mm, diameter 3–4 mm. 88–94 segments. Body depressed with a glandular creeping sole on *viii-ix* and from the male pores to the posterior end of the body. Colouration; purplish brown dorsally, pale ventrally. Clitellum *xiv-xvi*. First dorsal pore 10/11. Setae, *c.* 84 on *x*, *c.* 54 on *xix*, *c.* 52 on *xxv*, *c.* 44 on *xl*, setal ring crowded ventrally, especially on the creeping sole (*ab* = 0.6*yz* on *xix*).

Male pores simple within the creeping sole, *c.* 0.25 body circumference apart. Female pore single. Spermathecal pores small in 7/8/9, *c.* 0.25 body circumference apart.

Genital markings, none recorded.

Internal characters. All anterior septa present and delicate; intestine begins in *xv*, caeca absent but walls thickened and forming pouches in *xxii-xxix* and less conspicuously in *xxx-xxxviii*. Disposition of lateral hearts not recorded.

Holandric, testes sacs small single ventral in *x* and *xi*, seminal large in *xi* and *xii*, extending anteriorly to *ix* and posteriorly to *xvii*. Spermathecae (Fig. 27m) paired in *viii* and *ix*.

Description after Chen (1946).

DISTRIBUTION. Szechwan, China.

RECORDS. 3 specimens on bushy bamboos, Kiu-Lac-Tung, Mt Omei, Szechwan, China (types of *bambophila*).

METAPHERETIMA Michaelsen, 1928

Perichaeta (part): Beddard, 1895 : 388.

Amyntas (part): Beddard, 1900a : 612.

- Pheretima* (part): Michaelsen, 1900 : 234.
Pheretima (*Pheretima*) (part): Michaelsen, 1928a : 8.
Pheretima (*Metapheretima*) (part) Michaelsen, 1928a : 8.
Metapheretima (part): Sims & Easton, 1972 : 205, 233.
Pheretima (*Polypheretima*) (part): Michaelsen, 1934b : 15.
Ephemitra Sims & Easton, 1972 : 203, 232.

TYPE SPECIES. *Perichaeta neoguineensis* Michaelsen, 1892, original designation.

DIAGNOSIS. Megascolecidae with an oesophageal gizzard in *viii*, intestinal caeca and gizzards absent. Body cylindrical, setae never excessively crowded ventrally, creeping sole absent. Male pores lacking porophores, occasionally on slim penes which may be within copulatory pouches. Crescentic genital markings associated with the male pores on mature individuals of most species. Spermathecal pores small or large, spermathecal diverticula variable in structure and origin.

DESCRIPTION. Body cylindrical, creeping sole absent. Clitellum annular, usually restricted to three segments (*xiv-xvi*), rarely extending over more (*xiii, xvii*). First dorsal pore between 8/9 and 13/14. Setae perichaetine, never excessively crowded ventrally, dorsal and ventral gaps small ($aa = 1-2ab$, $zz = 1.2yz$). Lateral hearts in *x-xii* and sometimes *xiii*.

Oesophagus with a well-developed gizzard in *viii* and occasionally a pair of dorsal pouches in *x-xi*, calciferous glands absent. Intestine usually begins in *xv* or *xvi* but may begin more posteriorly in *xx*; simple, lacking caeca, gizzards and glandular walls.

Usually holandric, occasionally metandric, rarely proandric. The testes of each segment are enclosed in a single or paired sacs which are usually small and discrete, occasionally enclosing the anterior seminal vesicles. One pair of seminal vesicles in the segment directly posterior to each pair of testes. Prostates racemose. Paired, combined male and prostatic pores on the ventral surface of *xviii* in the setal ring. Male pores occasionally on slim penes, often within copulatory pouches; porophores absent.

Ovaries free in *xiii*. Oviducts lead to single or closely paired, midventral, equatorial pore(s) on *xiv*. Spermathecae differentiated into duct and ampulla, diverticula variable in structure and origin. Spermathecae usually arranged in pairs, infrequently in paired batteries of up to 8 spermathecae; in one to five adjacent segments between *v* and *ix*. Spermathecal pores small or slit-like, always intersegmental.

Genital markings of the discrete type or annular ridges; diffuse markings absent. In most species crescentic markings are closely associated with the male pores. In those species where they are absent the male pore may be surrounded by a pigmented annulus. The genital markings are usually arranged in pairs, they are never random or numerous (cf. *Polypheretima bifaria* and *patae* species-groups). The glandular tissue associated with the genital markings is restricted to the body wall and never invades the coelom.

DISTRIBUTION. (Fig. 7.) North and south east New Guinea, New Britain, Lombok. Species may be indigenous in the Carolines, Solomon Islands and New Hebrides.

NUMERICAL STUDIES. The taxa of the genus *Metapheretima* listed in Table 1 (7-36) were investigated numerically utilizing characters 3-29 in Table 2. Distributional data (characters 1 and 2) were not employed since the majority of taxa of *Metapheretima* are known only from New Guinea and the autochthony or otherwise of populations from elsewhere is uncertain.

The configuration of the taxa with the first and second vectors of the principal co-ordinates analysis as axes to which the MST with graded linkages has been added is shown in Fig. 31. Three divisions, indicated by circular, triangular and square symbols, may be recognized together with an isolated taxon *jocchana* (36) indicated by a star-shaped symbol.

Unlike the divisions recognized within the other acaecate genera reviewed above, those of *Metapheretima* form more diffuse configurations. Most of the taxa with simple male pores are accommodated in Division I. Species of this division usually have four to five thecal segments, ectal spermathecal diverticula and the male pores never possess annular ridges.

Taxa with male pores on penes are assigned to Divisions II and III; those with several thecal segments and ectal spermathecal diverticula form Division II while those with one or two thecal

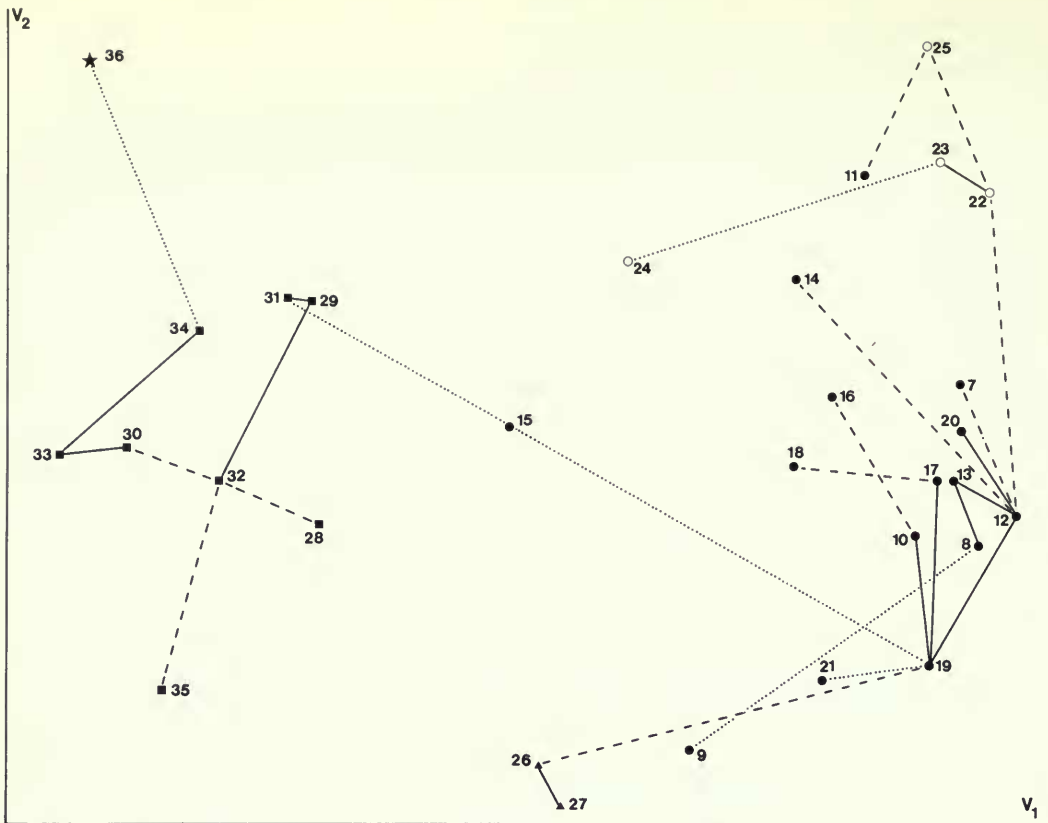


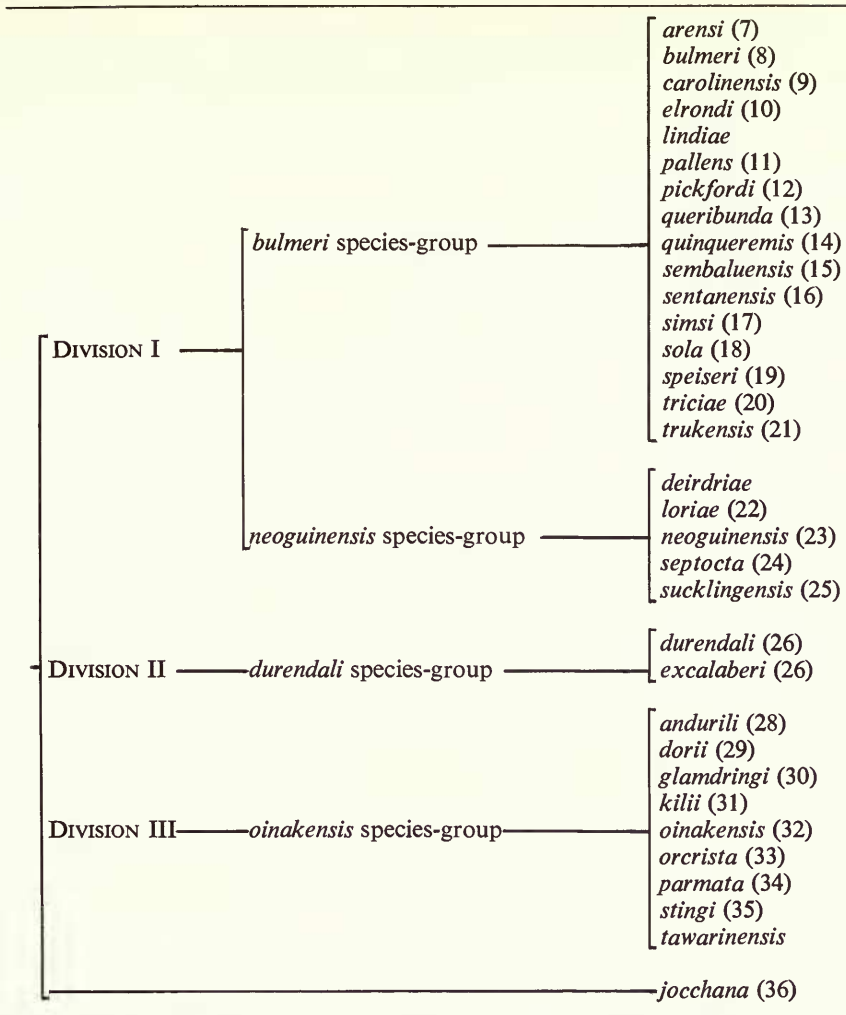
Fig. 31 Principal co-ordinates analysis of 30 species here assigned to *Metapheretima* (7–36 of Table 1): the configuration of species with the vectors corresponding to the first and second latent roots. The linkages of the added MST are graded to indicate percentage similarities; —, +95%; - - - - , 90–95%; ····, –90%. Three major assemblages and an isolated species are recognized: Division I – circular symbols (closed circles – *bulmeri* species-group, open circles – *neoguinensis* species-group). Division II – triangular symbols (*durendali* species-group). Division III – square symbols (*oinakensis* species-group). *Metapheretima jocchana* – star-shaped symbol.

segments and ental spermathecal diverticula form Division III. Annular ridges are often associated with the male pores of taxa included in Division III. The isolated taxon *jocchana* (36) has simple male pores encircled by annular ridges, a single thecal segment and numerous ental diverticula on the spermathecae.

Division I comprises two clusters, the members of each are denoted by closed or open circular symbols. Species 11 (*pallens*) has been included in the cluster with closed circular symbols because five of its six nearest neighbours belong to this group although it is linked by the MST to the other cluster. Species forming the two clusters may be distinguished by the form of the spermathecal diverticula. The cluster formed by closed circular symbols comprise taxa with simple diverticula, the *bulmeri* species-group; the other cluster with open circular symbols consist of the species with multiocular spermathecal diverticula, the *neoguinensis* species-group. The inclusion of the species *sembaluensis* (15) in Division I needs comment. Although its nearest neighbours belong to Division III (square symbols) it is assigned to Division I (circular symbols) since it lies intermediately between the two divisions and possesses the marker characters of Division I.

The two species of Division II form the *durendali* species-group while those of Division III comprise the *oinakensis* species-group.

Table 12 Phenetic classification and checklist of the genus *Metapheretima*



Numbers in parentheses indicate taxa assessed in numerical studies (see Figs 6 and 31).

Metandry or Holandry appears to be of little taxonomic value in the recognition of the species-groups within the genus *Metapheretima*. The importance of the number and distribution of testes in members of this genus is in contrast to the numerical study of the genus *Polypheretima* where these characters proved to be valuable indicators.

A summary of the phenetic classification based on this numerical study is given in Table 12.

Key to the species of the genus *Metapheretima*

1	First spermathecal pores in furrow 4/5	2
	First spermathecal pores in furrow 5/6	12
	First spermathecal pores in furrow 6/7	19
	First spermathecal pores in furrow 7/8	21
2	Two thecal segments	3
	Four thecal segments	<i>durendali</i> (part) (p. 105)
	Five thecal segments	4
3	Holandric; genital markings as Fig. 42a	<i>excalaberi</i> (p. 104)
	Metandric; genital markings as Fig. 34a	<i>arensi</i> (p. 83)

4(2)	Proandric or holandric	5
	Metandric	8
5	Setal numbers very low (less than 40 on <i>vii</i> even in large specimens) polythecal	<i>bulmeri</i> (p. 84)
	Setal numbers intermediate (bithecal)	6
	Setal numbers very high (more than 100 on <i>vii</i> even in small specimens) bithecal	<i>sentanensis</i> (p. 88)
6	Preclitellar genital markings single, spermathecal pores <i>c.</i> 0.50 body circumference apart	<i>pickfordi</i> ¹ (p. 91)
	Preclitellar genital markings paired, spermathecal pores 0.26–0.40 body circumference apart	7
7	Testes in <i>x</i> only	<i>queribunda</i> (p. 90)
	Testes in <i>x</i> and <i>xi</i>	<i>speiseri</i> (part) (p. 92)
8(4)	Spermathecal diverticulum simple	9
	Spermathecal diverticula multilocular	<i>loriae</i> (p. 99)
9	Spermathecal diverticulum short and ental in origin	<i>quinquerimis</i> (p. 85)
	Spermathecal diverticulum long and ectal in origin	10
10	Bithecal; preclitellar genital markings single or absent	11
	Polythecal; preclitellar genital markings paired	<i>lindae</i> (p. 89)
11	Postclitellar genital markings single (preclitellar genital markings absent)	<i>simsi</i> (p. 87)
	Postclitellar genital markings paired (preclitellar genital markings single)	<i>pickfordi</i> ¹ (p. 91)
12(1)	One or two thecal segments	<i>andurili</i> (p. 109)
	Three thecal segments	13
	Four thecal segments	15
13	Spermathecal pores numerous on dorsal surface	<i>carolinensis</i> (p. 96)
	Spermathecal pores paired on ventral surface	14
14	Male pores simple: genital markings as Fig. 39a	<i>trukensis</i> (p. 96)
	Male pores on penes within copulatory pouches; genital markings as Fig. 42b	<i>durendali</i> (part) (p. 105)
15(2)	Holandric	16
	Metandric	17
16	Preclitellar genital markings on <i>vii–ix</i>	<i>speiseri</i> (part) (p. 92)
	Preclitellar genital markings on <i>ix–xi</i>	<i>elrondi</i> (p. 93)
17(5)	Spermathecal diverticulum simple	18
	Spermathecal diverticulum multilocular	<i>neoguinensis</i> (p. 99)
18	Setal numbers low (less than 40 on <i>vii</i> even in large specimens)	<i>sola</i> (p. 93)
	Setal numbers high (more than 100 on <i>vii</i> even in small specimens)	<i>triciae</i> (p. 94)
19(1)	One or two thecal segments	<i>durendali</i> (part) (p. 105)
	Three thecal segments	20
20	Spermathecal diverticulum simple	<i>speiseri</i> (part) (p. 92)
	Spermathecal diverticulum multilocular	<i>sucklingensis</i> (p. 102)
21(1)	One thecal segment	22
	Two thecal segments	26
22	Spermathecal diverticulum simple	23
	Spermathecal diverticulum multilocular	<i>septocta</i> (p. 103)
	Spermathecal diverticulum numerous (Fig. 33p)	<i>jocchana</i> (p. 113)
23	Proandric	<i>glamdringi</i> (p. 113)
	Holandric	24
	Metandric	25
24	Postclitellar genital field as Fig. 43a	<i>tawarinensis</i> (p. 106)
	Postclitellar genital field as Fig. 44b	<i>stingi</i> (p. 109)
	Postclitellar genital field as Fig. 44c	<i>oinakensis</i> (p. 111)
	Postclitellar genital field as Fig. 45a	<i>orcrista</i> (p. 112)
	Postclitellar genital field as Fig. 45b	<i>parmata</i> (p. 112)
25(23)	Genital markings as Fig. 43b (spermathecal pores <i>c.</i> 0.20 body circumference apart)	<i>killi</i> (p. 107)
	Genital markings as Fig. 43c (spermathecal pores <i>c.</i> 0.37 body circumference apart)	<i>dorii</i> (p. 108)
26(21)	Holandric	<i>sembaluensis</i> (p. 98)
	Metandric	27

27	Spermathecal diverticulum simple	<i>pallens</i> (p. 98)
	Spermathecal diverticulum multilocular	<i>deirdrae</i> (p. 102)

¹ The unique holotype of *pickfordi* is damaged and may be holandric or metandric, it has therefore been keyed out twice to allow for either condition.

Metapheretima bulmeri species-group

DIAGNOSIS. *Metapheretima* with simple male pores lacking associated glandular ridges. Spermathecal diverticula simple.

SPECIES INCLUDED. *arensi*, *bulmeri*, *carolinensis*, *elrondi*, *lindiae*, *pallens*, *pickfordi*, *queribunda*, *quinqueremis*, *sembaluensis*, *sentanensis*, *simsi*, *sola*, *speiseri*, *triciae*, *trukensis*.

DISTRIBUTION. Species occur in all parts of the generic range.

REMARKS. The *bulmeri* species-group includes all the species of the genus *Metapheretima* possessing simple male pores with the exception of those which additionally have multilocular or numerous spermathecal diverticula. The latter are assigned to the *neoguinensis* species-group and to *jocchana* respectively. The results of the numerical studies failed to reveal any subassemblages with high percentage similarities indicative of subdivisions within the *bulmeri* species-group.

The inter-relationships of the species recorded from the New Hebrides and Solomon Islands are far from certain. Although each taxon is treated here as a separate species, it is probable that when further material becomes available they will be found to be conspecific.

Several of the species included in this group have the oesophagus modified in *x* and/or *xi* to form dorsal or dorsolateral pouches. Considerable variation in the degree of development of these structures may be encountered within individuals of a species. The presence of these pouches was utilized as a diagnostic generic character (*Ephemitra* Sims & Easton, 1972). The development of oesophageal pouches among the species of this group may to some extent be functionally correlated with the development of metandry since the enlargement of the oesophagus in *x* limits the space available for testes and testes sacs.

Marker characters of the species included in the *bulmeri* species-group are given in Table 13.

Metapheretima arensi (Ude, 1932)

Pheretima (*Metapheretima*) *arensi* Ude, 1932 : 168.

Metapheretima arensi: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one third of the body circumference apart in furrows 4/5/6. Metandric.

DESCRIPTION. *External characters*. Length 90–110 mm, diameter, 3.5–4 mm. 125–154 segments. Clitellum *xiv*–*xvi*. First dorsal pore 11/12. Setae, 140–150 on *vii*, 75–95 on *xx*, setal ring regular with ventral gaps ($aa = 2ab = 2y = 2zz$).

Male pore simple, *c*. 0.20 body circumference apart. Female pores paired. Spermathecal pores small, paired in 4/5/6, *c*. 0.30 body circumference apart.

Genital markings (Fig. 34a) single, median presetal on *ix* and *x*, paired, presetal in line with the male pores on *xvii* and *xix*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 membranous, 9/10 absent, 10/11 thickened. Oesophagus with small dorsal pouches in *x*–*xii*. Intestine begins in *xv*. Lateral hearts in *x*–*xiii*.

Metandric, testes sacs small, paired ventral in *xi*, seminal vesicles large, extending to the dorsal line in *xii*. Spermathecae (Fig. 32a) paired in *v* and *vi*.

DISTRIBUTION. New Britain.

MATERIAL EXAMINED. *Previously reported*. 3C, 1A Mejin bay, New Britain; Hamburg v3429 (syntypes of *arensi*) 2 other specimens from this series have been re-identified as *Pithemera pacifica* (Beddard, 1899); Hamburg v10032. 1A Aid river, New Britain; Hamburg v3458 (syntype of *arensi*). 1C Lieblide Island, New Britain; Hamburg v10031 (syntype of *arensi*).

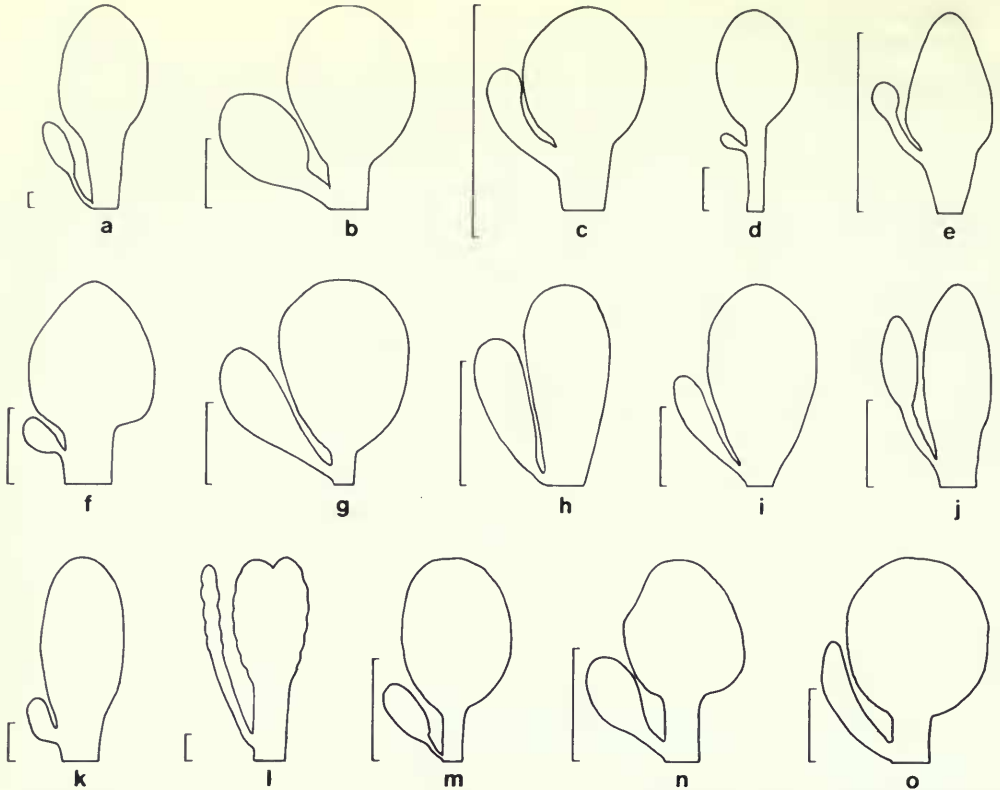


Fig. 32 Spermathecae. (a) *Metapheretima arensi*; (b) *M. bulmeri*; (c) *M. lindiae* sp. nov.; (d) *M. quinquereemis* sp. nov.; (e) *M. simsi* sp. nov.; (f) *M. sentanensis*; (g) *M. queribunda*; (h) *M. speiseri*; (i) *M. elrondi* sp. nov.; (j) *M. sola* sp. nov.; (k) *M. triciae* sp. nov.; (l) *M. trukensis*; (m) *M. carolinensis*; (n) *M. sembaluensis*; (o) *M. pallens*. All scales 0.5 mm.

New record. 1C Tu Island, New Britain. This specimen was removed from a series of *Pithemera sedgewicki typica*: Ude, 1932; Hamburg v3470.

Metapheretima bulmeri (Gates, 1970)

Pheretima bulmeri Gates, 1970b : 386.

Metapheretima bulmeri: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; numerous spermathecal pores in paired batteries about one quarter of the body circumference apart in furrows 4/5/6/7/8/9. Holandric. Setal numbers low (cf. *kinabaluensis* Fig. 2) diverticula simple, ectal.

DESCRIPTION. *External characters.* Length 200–340 mm, diameter 10–14 mm. 105–129 segments. Clitellum *xiv–xvii*. First dorsal pore 12/13. Setae, *c.* 42 on *vii*, *c.* 50 on *xx*, setal ring regular with dorsal gaps ($aa = ab = yz = 0.5zz$).

Male pores simple, *c.* 0.20 body circumference apart. Female pore single. Spermathecal pores small, numerous in paired batteries of up to 7 pores in 4/5/6/7/8/9, *c.* 0.28 circumference apart.

Genital markings (Fig. 34b), only those diagnostic of the genus.

Internal characters. Septa 4/5–7/8 membranous, 8/9/10 absent, 10/11 membranous, 11/12–14/15 slightly thickened. Oseophagus unmodified. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Holandric, testes sacs small, paired in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*. Pseudoseminal vesicles in *xiii*. Spermathecae (Fig. 32b), numerous, arranged in paired batteries of up to 7 spermatheca in *v–ix*.

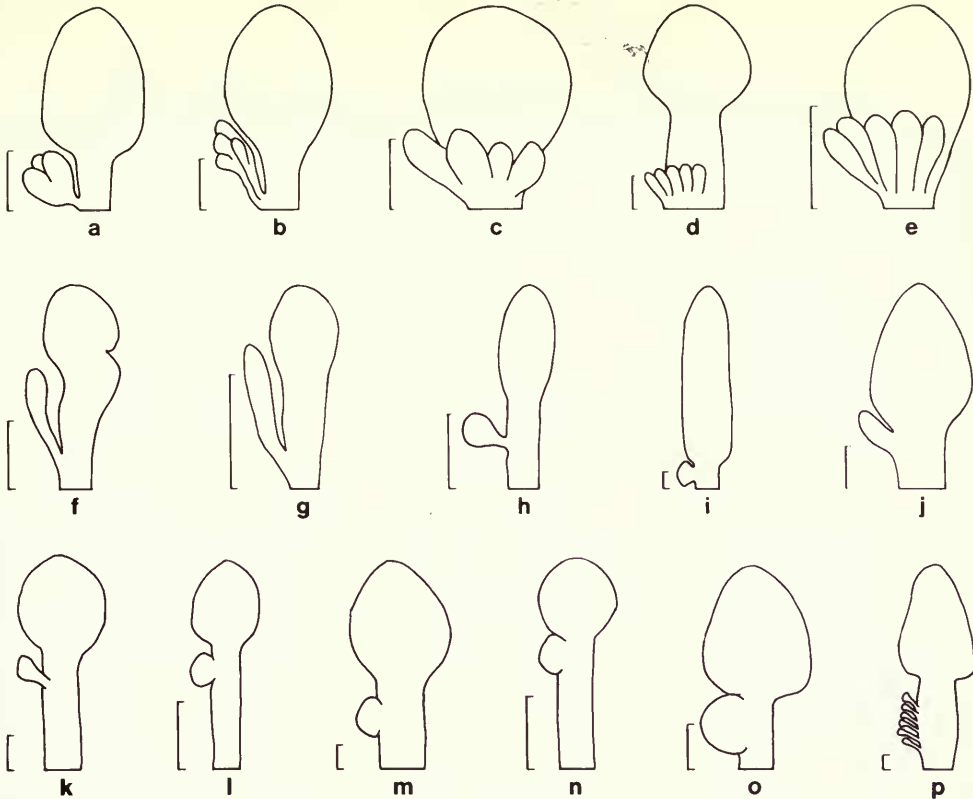


Fig. 33 Spermathecae. (a) *Metapheretima loriae*; (b) *M. neoguineensis*; (c) *M. sucklingensis* sp. nov.; (d) *M. dierdrae* sp. nov.; (e) *M. septocta* sp. nov.; (f) *M. excalaberi* sp. nov.; (g) *M. durendali* sp. nov.; (h) *M. tawarinensis*; (i) *M. kilii* sp. nov.; (j) *M. dorii* sp. nov.; (k) *M. andurili* sp. nov.; (l) *M. stingi* sp. nov.; (m) *M. oinakensis*; (n) *M. orcrista* sp. nov.; (o) *M. glamdringi* sp. nov.; (p) *M. jochhana*. All scales 0.5 mm.

DISTRIBUTION. North east New Guinea.

MATERIAL EXAMINED. *Previously reported.* 2C Schrader range, Papua New Guinea; Sydney v4259 (syntypes of *bulmeri*). I am indebted to Dr B. G. M. Jamieson, University of Queensland, for examining the types and for making drawings on which the figures of the genital markings and spermathecae are based.

New record. 1C, 1A Schrader range, Papua New Guinea; BMNH 1976.2.1-2.

Metapheretima quinquereinis sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one fifth of the body circumference apart in furrows 4/5/6/7/8/9. Metandric. Setal numbers intermediate (cf. *elongata*, Fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters.* Length 86-122 mm, diameter 4-5 mm. 73-97 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, 40-44 on *vii*, 41-44 on *xx*, setal ring regular with dorsal and ventral gaps ($aa = 1.5ab = 1.5yz = zz$).

Male pores simple *c.* 0.20 body circumference apart. Female pores paired. Spermathecal pores small, paired, in 4/5/6/7/8/9, *c.* 0.20 body circumference apart.

Genital markings (Fig. 35a), large, paired, presetal slightly median to the spermathecal pores on *vi-ix*, in line with the male pores on *xvii, xix-xx*.

Table 13 Marker characters of the *Metapheretima bulmeri* species-group

Species	Spermathecal furrows	Separation of spermathecal pores	Setal density ¹	Genital markings (S = single, P = paired)		Testes (P = proandric, H = holandric, M = metandric)	Distribution
				Preclitellar	Postclitellar		
<i>arensi</i>	4/5/6	0.30	h	S, ix, x	P, xvii, xix	M	New Britain
<i>bulmeri</i>	4/5/6/7/8/9	0.28 (polythecal)	l	-	-	H	New Guinea
<i>quinquerentis</i>	4/5/6/7/8/9	0.20	i	P, vi-ix	P, xvii, xix-xx	M	New Guinea
<i>simsi</i>	4/5/6/7/8/9	0.35	i	-	S, xvii-xx	M	New Guinea
<i>sentanensis</i>	4/5/6/7/8/9	0.20-0.29	h	P, viii-x	P, xvii, xix-xxv	H	New Guinea
<i>lindiae</i>	4/5/6/7/8/9	0.23 (polythecal)	h	P, ix	P, xvii, xix-xxiii	M	New Guinea
<i>queribunda</i>	4/5/6/7/8/9	0.35	h	P, vi-ix	P, xvii, xx-xxii	P ²	Solomon Is.
<i>pickfordi</i>	4/5/6/7/8/9	0.50	h	S, vii-ix	P, xvii, xix-xxiii	? M	Solomon Is.
<i>speiseri</i>	4/5/6/7/8/9 5/6/7/8/9 or 6/7/8/9	0.26-0.40	i	P, vii-ix	P, xvii, xix-xx	H	New Hebrides
<i>elrondi</i>	5/6/7/8/9	0.25	h	P, ix-xi	P, xvii, xix-xxiii	H	New Guinea
<i>sola</i>	5/6/7/8/9	0.08	l	P, vi-ix	P, xvii, xix-xxi	M	New Guinea
<i>triciae</i>	5/6/7/8/9	0.20-0.26	h	P, vii-x	P, xvi-xxi	M	New Guinea
<i>trukensis</i>	5/6/7/8	0.10	l	-	P, xvii, xix-xxi	H	Caroline Is.
<i>carolinensis</i>	5/6/7/8	0.90 (polythecal)	i	-	-	H	Caroline Is.
<i>sembaluensis</i>	7/8/9	0.20	i	P, viii-ix	P/S xvii-xx	H	Lombok
<i>pallens</i>	7/8/9	0.31	h	P, viii-x	P, xvii, xx-xxii	M	New Guinea

¹ For details of setal densities see Fig. 2. Low = cf. *kinabaluensis*, intermediate = cf. *elongata*, high = cf. *sentanensis*.

² Although proandric, *queribunda* has testes sacs in xi as well as x.

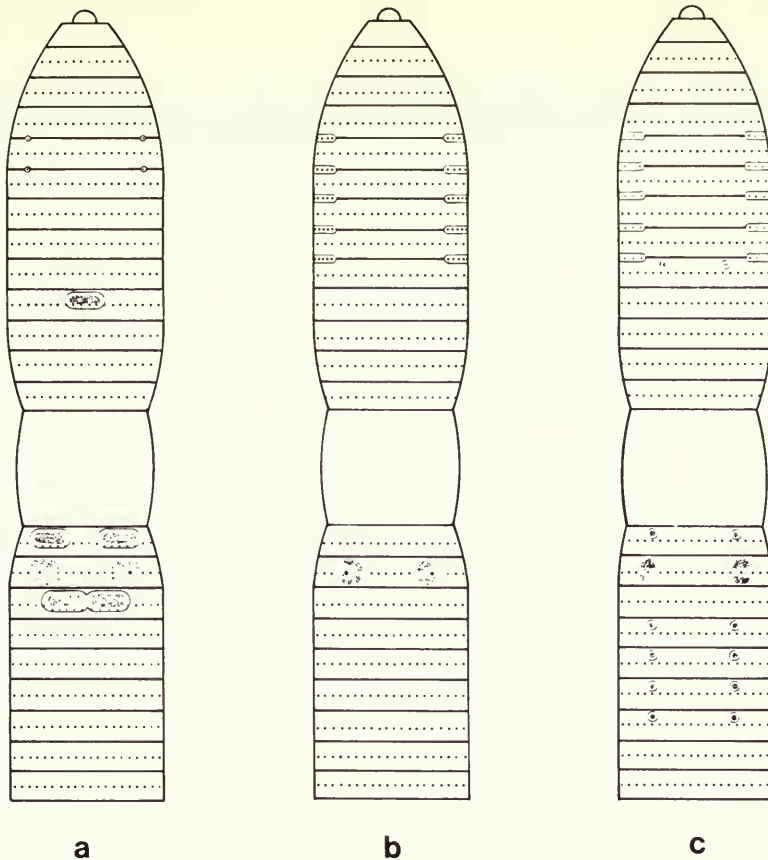


Fig. 34 Anterior ventral surface, diagnostic characters. (a) *Metapheretima arensi*; (b) *M. bulmeri*; (c) *M. lindiae* sp. nov.

Internal characters. Septa 4/5–12/13 present and membranous. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs small, paired, ventral in *xi*, seminal vesicles large, extending to the dorsal line in *xii*. Pseudoseminal vesicles prominent in *xiv*. Spermathecae (Fig. 32d) paired in *v–ix*.

DISTRIBUTION. South east New Guinea.

MATERIAL EXAMINED. 25C, 1A Mt Suckling, Papua New Guinea, 9° 46' S, 149° 00' E, coll W H Ewer 1972; BMNH 1976.4.30–54 (syntypes of *quinqueremis*). 1C Gentle ridge, Bismarck range, Eastern Highland district, Papua New Guinea, 5° 57' S, 145° 15' E, 2500 m, coll D R Kershaw 14 Jul 1971; BMNH 1976.5.116.

Metapheretima simsi sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; spermathecal pores about one third of the body circumference apart in furrows 4/5/6/7/8/9. Metandric. Setal numbers intermediate (cf. *elongata*, Fig. 2). Postclitellar genital markings single, median, presetal. Spermathecal diverticula simple, ectal.

DESCRIPTION. External characters. Length *c.* 36 mm, diameter *c.* 1.5 mm. C. 118 segments. Clitellum *xiv–xvi*. First dorsal pore not detectable in preclitellar furrows. Setae, *c.* 41 on *vii*, *c.* 30 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple, *c.* 0.24 body circumference apart. Female pores paired. Spermathecal pores small, paired, in 4/5/6/7/8/9, *c.* 0.35 body circumference apart.

Genital markings (Fig. 35b) oval, single, presetal, median on *xvii-xx*.

Internal characters. Septa 6/7/8 thickened, 8/9–13/14 membranous. Oesophagus simple. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs large, paired with dorsal link in *xi*, seminal vesicles extending to the lateral line in *xii*. Spermathecae (Fig. 32e) paired in *v-ix*.

DISTRIBUTION. New Guinea.

REMARKS. The possession of single median postclitellar genital markings distinguishes this species from all other members of the genus *Metapheretima* with five thecal segments.

MATERIAL EXAMINED. 1C Waitape, Goilala, Papua New Guinea, 8° 22' S, 147° 03' E, altitude 1500 m, coll Griffiths 2 Jul 1972; BMNH 1976.10.19 (holotype of *simsi*).

Metapheretima sentanensis (Cognetti, 1911)

Pheretima sentanensis Cognetti, 1911 : 5; Cognetti, 1912 : 551.

Ephemitra sentanensis: Sims & Easton, 1972 : 181, 204, 232.

Pheretima myritchasta (sic) Cognetti, 1911 : 4.

Pheretima myriochaeta: Cognetti, 1912 : 549.

Ephemitra myriochaeta: Sims & Easton, 1972 : 181, 232.

Pheretima ardata Cognetti, 1914 : 353.

Pheretima (*Pheretima*) *ardita*: Ude, 1932 : 145.

Ephemitra ardata: Sims & Easton, 1972 : 180, 232.

Pheretima tamiensis Ude, 1924 : 84.

Pheretima (*Pheretima*) *tamiensis*: Ude, 1932 : 136.

Metapheretima tamiensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one quarter of the body circumference apart in furrows 4/5/6/7/8/9. Holandric. Setal numbers high (Fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters.* Length 25–145 mm, diameter 1.5–5 mm. 90–212 segments. Clitellum *xiv-xvi*. First dorsal pore occasionally 8/9/10 but usually 12/13. Setae, 100–300 on *vii*, 50–128 on *xx*, setal ring regular but occasionally with displaced setae forming double rings (*aa = ab = yz = zz*).

Male pores simple, *c.* 0.20–0.27 body circumference apart. Female pore single, rarely paired. Spermathecal pores small, paired, 4/5/6/7/8/9, *c.* 0.20–0.29 body circumference apart.

Genital markings (Fig. 35c, d) paired, median to the line of the spermathecal pores, presetal on *viii-x* and occasionally postsetal on *viii* and *ix*, in line with or slightly median to the male pores, presetal on *xvii*, *xix-xxv*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 membranous, 9/10 membranous or absent, 10/11 membranous, 11/12 membranous or absent, 12/13/14 membranous. Paired dorsal oesophageal pouches in *x*. Intestine begins in *xvi*. Lateral hearts in *x-xii*.

Holandric, testes sacs paired in *x*, single in *xi*, extending to the dorsal line, seminal vesicles in *xi* and *xii*, those of *xi* enclosed in the testes sacs. Pseudoseminal vesicles in *xiii* and occasionally *xiv*. Spermathecae (Fig. 32f) paired in *v-ix*.

DISTRIBUTION. New Guinea.

REMARKS. The types of *ardita*, *myriochaeta* and *tamiensis* differ from the type series of *sentanensis* principally in segment size and setal numbers. The species *tamiensis* was originally described as having four pairs of spermathecae but a re-examination of the single extant syntype revealed the presence of five pairs. In view of the correlation between setal and segmental development these differences do not appear to be taxonomically significant.

Most specimens examined had only presetal genital markings associated with the spermathecal pores, both pre- and postsetal markings were present in a minority which additionally appeared to have slightly lower setal numbers, but no conclusive correlations could be established.

MATERIAL EXAMINED. *Previously reported.* 13C, 3A Near lake Sentani, Jaga (Jocchana), West Irian; Amsterdam Vol. 301 (syntypes of *sentanensis*). 3 other specimens from this series are at Turin (01. 193), they were not examined. 1C Near Tawarin river, west of Mt Cyclops, West Irian; Amsterdam Vol. 289 (holotype of *myriochaeta*). 1C Bivouac 'Zoutbron' on river Begowre, West Irian, 3° 1' 13" S, 140° 57' 30" E; Leiden 1827 (holotype of *ardita*). 2C, 3A Tami, Papua New Guinea; Berlin 6464 (*ardita*: Ude, 1932). 1C Tami, Papua New Guinea; Berlin 6462 (syntype of *tamiensis*).

New records. 1C, 12A Kaironk valley, Simbai region, Madang district, Papua New Guinea, 1750–1950 m, coll R N H Bulmer 8–12 Nov 1973; BMNH 1976.2.8–20. 6A Dense clay with dense organic matter and thin grass cover, side of road adjacent to coffee plantation, Amahab village c. 16 km west of Maprik, Sepik district, Papua New Guinea, coll J W Copland 12 Nov 1971; BMNH 1976.3.100–105. 2A Dry to moist loam covered by grass and small trees, bank of river, Sepik Plains Livestock Station, Urimo, Sepik district, Papua New Guinea, coll J W Copland 1971; BMNH 1976.3.106–107. 10A Moist medium to heavy dark loam with considerable organic content covered by a mat of *paspalum*, bank of small creek running through No. 12 paddock, Sepik Plains Livestock Station. Urimo, Sepik district, Papua New Guinea, coll J W Copland 11 Nov 1971; BMNH 1976.3.108, 109–118. 13C, 8A 15 cm layer of black soil over sandy soil cultivated for gardens, halfway down hill to creek, Department of Agriculture, Stock and Fisheries Piggery, Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 13 Oct 1971; BMNH 1976.3.87–96, 119–129. 1C, 2A Dark sandy loam covered by light vegetation, 120–150 m above Nupa village, c. 24 km east of Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 1971; BMNH 1976.1.97, 98–99. 6C, 8A DASF Piggery, Goroka, Papua New Guinea, coll J W Copland 13 Oct 1971; BMNH 1977.1.78–81, 141–150. 1C, 1A Bank of creek, DASF Piggery, Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 23 Aug 1972; BMNH 1977.1.100–101. 7C, 1A Locality as above; coll J W Copland 1 Sep 1971; BMNH 1977.1.68–75. 1C Nupa village, c. 24 km east of Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 13 Oct 1971; BMNH 1977.1.60. 14C, 25A Locality as above, coll J W Copland 31 Aug 1971; BMNH 1977.1.102–140. 3C, 1A Moist dense mixture of peat and soil, very rich in humus, Land Resettlement Scheme (area drained 3 years prior to collection), Kendig, Mt Hagen, Western Highlands, Papua New Guinea, coll J W Copland 1971; BMNH 1976.3.73–76. 3C, 1A DASF station, Kendig, Mt Hagen, Western Highlands, Papua New Guinea, coll J W Copland 15 Nov 1971; BMNH 1977.1.61–63. 3C Moist dark loam of moderate to high organic content, sloping plot being prepared for Kaukau, on boundary of Webag, Mt Hagen, Western Highlands, Papua New Guinea, coll J W Copland 16 Nov 1971; BMNH 1976.3.77–78, 79. 9C, 2A Local government council piggery, west of Webag, Mt Hagen, Western Highlands, Papua New Guinea, coll J W Copland 16 Nov 1971; BMNH 1976.3.80–86, 1977.1.64–67. 2C Webag, Mt Hagen, Western Highlands, Papua New Guinea, coll J W Copland 16 Nov 1971; BMNH 1977.1.76–77. 15C, 3A Kasena, Papua New Guinea, coll J W Copland 25 Aug 1972; BMNH 1977.1.82–99. 2C, 1A Madang district, Papua New Guinea, coll R. Phipps; BMNH 1976.8.33–35.

Metapheretima lindiae sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; numerous spermathecal pores in paired batteries about one fifth of the body circumference apart in furrows 4/5/6/7/8/9. Setal numbers high (cf. *sentanensis*, Fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters.* Length 54–60 mm, diameter c. 1.5 mm. C. 105–143 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12. Setae, 94–100 on *vii*, 34–49 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple c. 0.22 body circumference apart. Female pore(s) not detected. Spermathecal pores small, numerous, arranged in paired batteries of 1–4 in 4/5/6/7/8/9, batteries c. 0.23 body circumference apart.

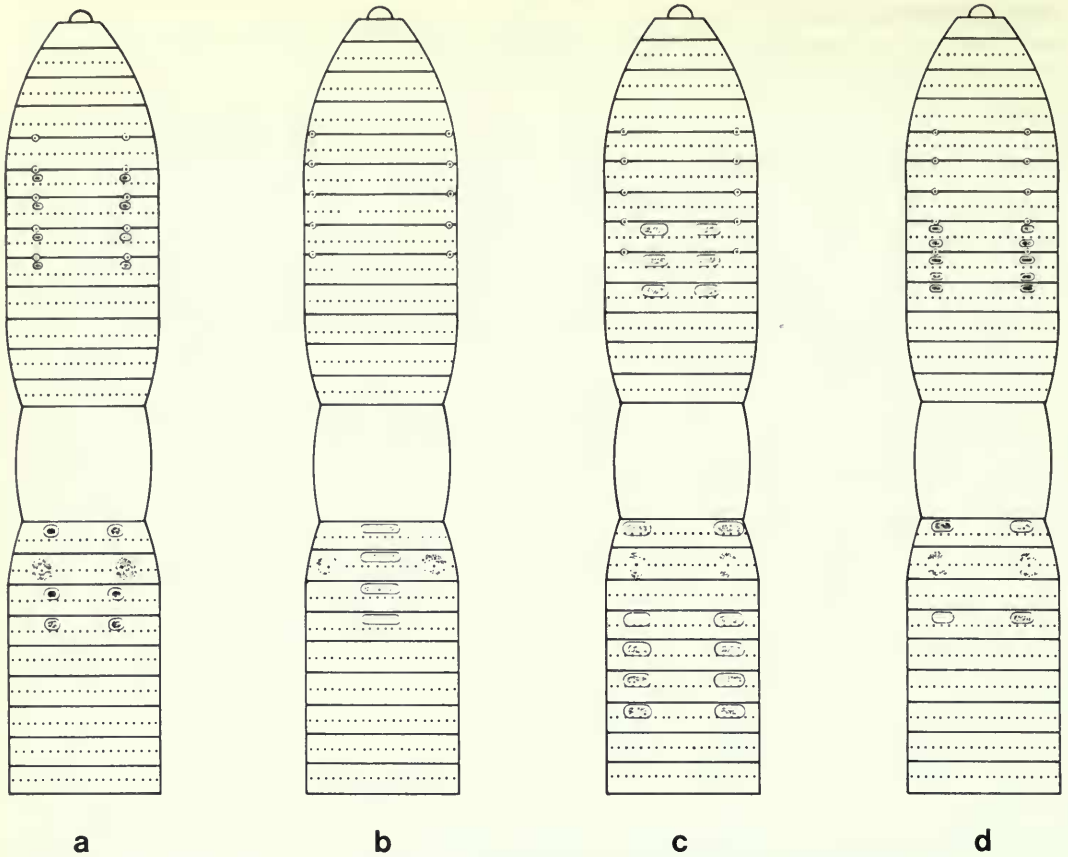


Fig. 35 Anterior ventral surface, diagnostic characters. (a) *Metapheretima quinquereimis* sp. nov.; (b) *M. simsi* sp. nov.; (c) *M. sentanensis*, syntypic individual; (d) *M. sentanensis*, variant individual.

Genital markings (Fig. 34c) paired, presetal on *ix* median to the line of the spermathecal pores, on *xvii*, *xx-xxiii* in line with the male pores.

Internal characters. Septa 5/6/7/8 thickened, 8/9 membranous, 9/10 not detected, 10/11-13/14 slightly thickened. Oesophagus simple. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs large, paired, extending to the dorsal line in *xi*, seminal vesicles large, extending to the dorsal line in *xii*, Pseudoseminal vesicles small in *xiii* and *xiv*. Spermathecae (Fig. 32c) numerous in paired batteries of 1-4 spermathecae in *v-ix*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 2C Madang district, Papua New Guinea 5° 14' S, 145° 45' E, coll R Phipps; BMNH 1976.8.1-2 (syntypes of *lindiae*).

Metapheretima queribunda (Gates, 1958)

Pheretima queribunda Gates, 1958 : 25.

Metapheretima queribunda: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one third of the body circumference apart in furrows 4/5/6/7/8/9. Proandric.

DESCRIPTION. *External characters.* Length 75-80 mm, diameter 4-6 mm. 120-135 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, 96-120 on *vii*, c. 86 on *xx*, setal ring regular with ventral gaps on postclitellar segments ($aa=2ab=2yz=2zz$).

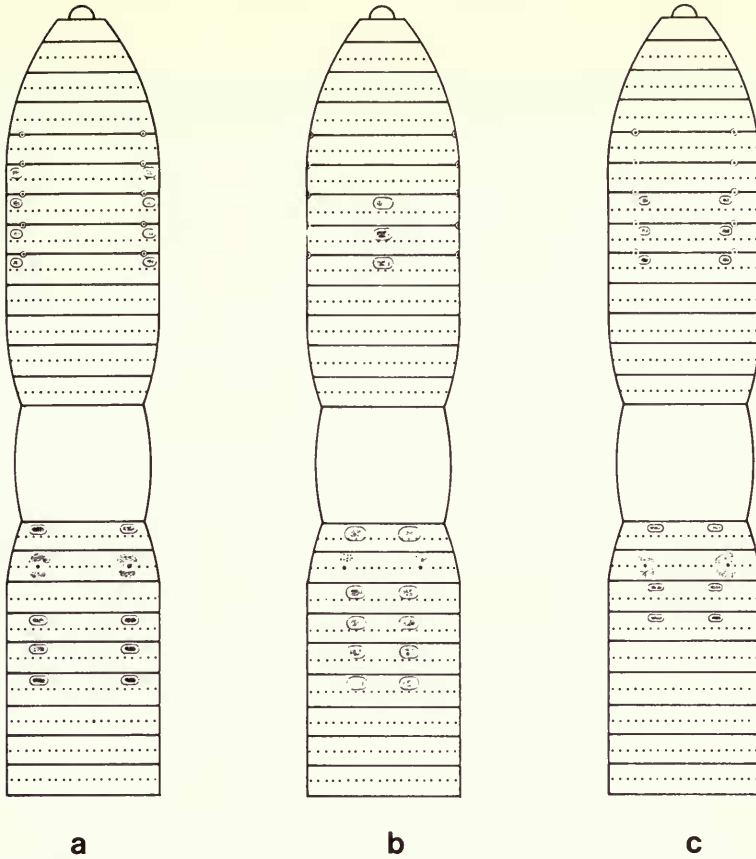


Fig. 36 Anterior ventral surface, diagnostic characters. (a) *Metapheretima queribunda*; (b) *M. pickfordi*; (c) *M. speiseri*.

Male pores simple, $c. 0.24$ body circumference apart. Female pores paired. Spermathecal pores small, paired in $4/5/6/7/8/9$, $c. 0.35$ body circumference apart.

Genital markings (Fig. 36a) paired, presetal, slightly lateral to the spermathecal pores on *vi-ix*, in line with the male pores on *xvii*, *xix-xxii*.

Internal characters. Septa $5/6/7/8$ thickened, $8/9$ membranous or absent, $9/10$ absent, $10/11/12/13$ membranous. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Proandric, testes sacs paired, extending to the lateral line in *x*, single, extending to the dorsal line in *xi* (but lacking testes), seminal vesicles small, in *xi* enclosed in the testes sacs and *xii*. Pseudoseminal vesicles absent. Spermathecae (Fig. 32g) paired in *v-ix*.

DISTRIBUTION. Solomon Islands.

REMARKS. *M. queribunda* is noteworthy in that, although the posterior pair of testes are absent, the testes sacs of *xi* and the seminal vesicles of *xii* remain. Because of this condition it may be confused with the holandric species of the *bulmeri* species-group.

MATERIAL EXAMINED. *Previously reported.* 1C Gaudalcanal, Solomon Islands; New York 3505 (holotype of *queribunda*).

New record. 1C Under log, Russell Island, Solomon Islands, 15 m; coll R A Lever Feb 1934; BMNH 1935.1.18.1.

Metapheretima pickfordi (Gates, 1957)

Pheretima pickfordi Gates, 1957 : 18; Lee, 1969 : 4.

Metapheretima pickfordi: Sims & Easton, 1972 : 231.

? *Perichaeta loriae*: Beddard, 1899 : 185 (*non* Rosa, 1898b : 61).

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about half of the body circumference apart in furrows 4/5/6/7/8/9. Setal numbers high (cf. *sentanensis*, fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters*. Length *c.* 26–28 mm, diameter *c.* 3 mm. *C.* 111 segments. Clitellum *xiv*– $\frac{1}{2}$ *xvi*. Dorsal pores not recognized in preclitellar furrows. Setae, 80–90 on *vi*, *c.* 40 on *xx*, setal ring with small dorsal and ventral gaps.

Male pores simple, 'well lateral to the midventral line'. Female pores paired. Spermathecal pores paired in 4/5/6/7/8/9, *c.* 0.50 body circumference apart.

Genital markings (Fig. 36b) presetal, single, median on *vii*–*ix*, paired, extending laterally as far as the male pores on *xvii*, *xix*–*xxiii*.

Internal characters. Anterior septa delicate, 8/9 present, 9/10/11 not recognized. Intestine begins in *xv*. Last lateral hearts in *xii*.

Probably metandric, testes sacs single in *xi*, seminal vesicles small in *xii*. Spermathecae, paired in *v*–*ix*, ampulla elongate, duct short, diverticula slightly longer than main chamber.

Description after Gates (1957); Fig. 36b is an interpretation of the genital field based on Gates's written description.

DISTRIBUTION. Solomon Islands.

REMARKS. It is uncertain whether *M. pickfordi* is holandric or metandric. Gates (1957) could not recognize the testes in *x* because of the decomposed condition of the type series and Lee (1969) did not comment on the condition of the testes in the specimens he examined.

RECORDS. 1C, 1A Coconut grove, Lavanggu, Rennell Island, Solomon Islands (types of *pickfordi*). Guadalcanal (*pickfordi*: Lee, 1969).

Metapheretima speiseri (Michaelsen, 1913)

Pheretima speiseri Michaelsen, 1913b : 263.

Pheretima (Pheretima) speiseri: Pickford, 1929 : 493.

Planapheretima speiseri: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; spermathecal pores about one third of the body circumference apart in furrows (4/5/6) 6/7/8/9. Holandric. Setal numbers intermediate (cf. *elongata*, fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters*. Length 26–80 mm, diameter 2–3 mm. 78–96 segments. Clitellum *xiv*–*xvi*. First dorsal pore 12/13. Setae, 32–54 on *vii*, 36–56 on *xx*, setal ring regular, occasionally with slight ventral gaps (*aa* = 1–1.5*ab* = *yz* = *zz*).

Male pores simple, *c.* 0.22 body circumference apart. Female pores paired. Spermathecal pores small, paired in 6/7/8/9 and usually 5/6 and 4/5, *c.* 0.26–0.40 body circumference apart.

Genital markings (Fig. 36c), paired, presetal, median or slightly lateral to the line of the spermathecal pores on *vii*–*ix*, in line with the male pores on *xvii*, *xix*–*xx*.

Internal characters. Septa 5/6/7/8 slightly thickened, 8/9 membranous or absent, 9/10–13/14 slightly thickened. Intestine begins in *xv*. Lateral hearts in *x*–*xii*.

Holandric, testes sacs paired, small, ventral in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*. Spermathecae (Fig. 32h) paired, usually in *v*–*ix*, those of *v* and *vi* may be absent.

DISTRIBUTION. New Hebrides.

REMARKS. The type series of *speiseri* and the specimens identified by Pickford (1929) display considerable variation in the development of the posterior male organs and spermathecae. Michaelsen (1913) recognized two conditions (A and B) and Pickford (1929) a third (C) to which she provided the following diagnosis:

A-form without prostates and male pores but with fully developed spermathecae.

B-form with prostates and male pores but with reduced spermathecae.

C-form with prostates, male pores and fully developed spermathecae.

Variation of this kind is often encountered among the species of the *Pheretima* group, especially in introduced populations where it has been utilized to establish the indigenous range of some species (Gates, 1956; Easton, 1976). It is not considered to have any taxonomic significance. Nevertheless, the single example examined of form A has more widely paired spermathecal pores (*c.* 0.40) than individuals of both forms B and C (*c.* 0.26), and more closely paired preclitellar genital markings.

MATERIAL EXAMINED. *Previously reported.* 2C Espiritu Santo, New Hebrides; Hamburg v8071 (syntypes of *speiseri*). 8A Summit of Tabwe Masana, Espiritu Santo, New Hebrides; BMNH 1929.6.11.1–7 (*speiseri*: Pickford, 1929). 1C, 2A Near shore of lake, Gaua, New Hebrides; BMNH 1928.3.22.11 (*speiseri*: Pickford, 1929). Fragments of 1C, data as above; Hamburg v11966 (*speiseri*: Pickford, 1929).

New record. 6C Tatarii, west Santo, New Hebrides; BMNH 1934.3.6.24–26.

Metapheretima elrondi sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one quarter of the body circumference apart in furrows 5/6/7/8/9. Holandric. Setae numerous (cf. *sentanensis*, Fig. 2). Spermathecal diverticula simple.

DESCRIPTION. *External characters.* Length 50–133 mm, diameter *c.* 5 mm. *C.* 106 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, 88–220 on *vii*, 40–60 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores simple, *c.* 0.25 body circumference apart. Female pores paired. Spermathecal pores small, paired in 5/6/7/8/9, *c.* 0.25 body circumference apart.

Genital markings (Fig. 37a) paired, presetal, slightly median to the line of the spermathecal pores on *ix–xi*, slightly median to the line of the male pores on *xvii*, *xx–xxiii*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 slightly thickened, 9/10 and succeeding septa delicate. Intestine begins in *xvi*. Lateral hearts in *x–xii*.

Holandric, testes sacs paired, ventral with dorsal connections over the oesophagus in *x* and *xi*; seminal vesicles small, those of *xi* enclosed in the testes sacs. Pseudoseminal vesicles in *xiv*. Spermathecae (Fig. 32i) paired in *vi–ix*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 6C, 3A Soil of alluvial clay derived from gabbro, pH 5.5–6.3, highly humidified, organic content 15–30%, C/N ratio 8–9. Gentle ridge covered in mixed lower montane forest with *Podocarpus*, *Eleocarpaceae*, *Lauraceae*, *Cunoniaceae* dominant, Bismark range, Eastern Highland district, Papua New Guinea, 5° 58' S, 145° 15' E, rainfall 890 cm/year, altitude 2500 m, coll D R Kershaw 20 Jul 1971; BMNH 1976.5.116–124 (syntypes of *elrondi*). 13C, 18A Locality and collector as above; BMNH 1976.5.125–156. 2C, 4A Locality and collector as above; Papua New Guinea.

Metapheretima sola sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; closely paired spermathecal pores in furrows 5/6/7/8/9. Metandric. Setae sparse (cf. *kinabaluensis*, Fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters.* Length *c.* 96 mm, diameter *c.* 4 mm. *C.* 76 segments. Clitellum *xiv–xvi*, first dorsal pore 12/13. Setae, *c.* 27 on *vii*, *c.* 41 on *xx*, setal ring slightly crowded ventrally ($2aa = 2ab = yz = zz$).

Male pores simple, *c.* 0.08 body circumference apart. Female pores paired. Spermathecal pores large, paired, in 5/6/7/8/9, *c.* 0.08 body circumference apart.

Genital markings (Fig. 37b), paired, presetal, in line with the spermathecal pores on *vi–ix*, in line with the male pores on *xvii*, *xix–xxi*.

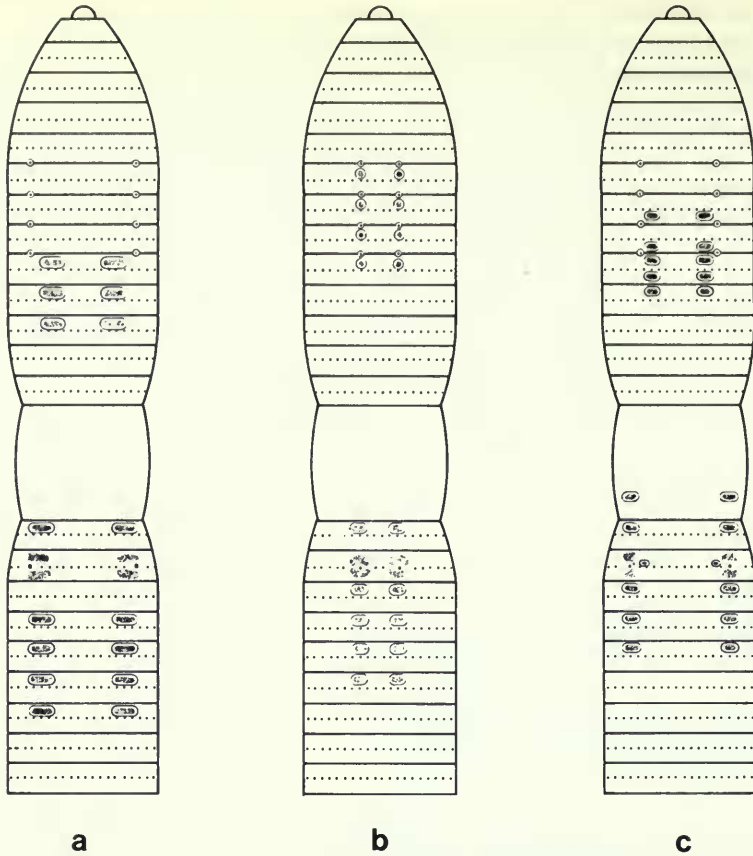


Fig. 37 Anterior ventral surface, diagnostic characters. (a) *Metapheretima elrondi* sp. nov.; (b) *M. sola* sp. nov.; (c) *M. triciae* sp. nov. typical individual.

Internal characters. Septa 5/6/7/8 membranous, 8/9 absent, 9/10–12/13 slightly thickened. Oesophagus with slight, dorsolateral pouches in *xi*. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs large, paired, ventral in *xi*, seminal vesicles large, extending to the dorsal line in *xii*. Pseudoseminal vesicles absent. Spermathecae (Fig. 32j) paired in *vi–ix*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 1C Mt Suckling, Papua New Guinea, 9° 46' S, 149° 00' E, coll W H Ewer Jun 1972; BMNH 1976.4.63 (holotype of *sola*).

Metapheretima triciae sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores one third to one sixth of the body circumference apart in furrows 5/6/7/8/9. Metandric. Setal numbers high (Fig. 2). Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters.* Length 65–114 mm, exceptionally 235 mm, diameter 3–5 mm, exceptionally 8 mm. 110–156 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12 or 12/13. Setae, 100–135 (188) on *vii*, 41–60 (140) on *xx*, setal ring usually single, occasionally double on *iv–xi*; regular with dorsal and ventral gaps on postclitellar segments ($aa = 2ab = 2yz = zz$).

Male pores simple, 0.17–0.26 body circumference apart. Female pores single or paired. Spermathecal pores small, paired, in 5/6/7/8/9, 0.14–0.35 body circumference apart.

Genital markings highly variable (Figs 37c, 38) paired, presetal on *vi–x*, postsetal on *vi–ix*, one or more pairs, presetal on *xvi–xxiii*, postsetal on *xvii*.

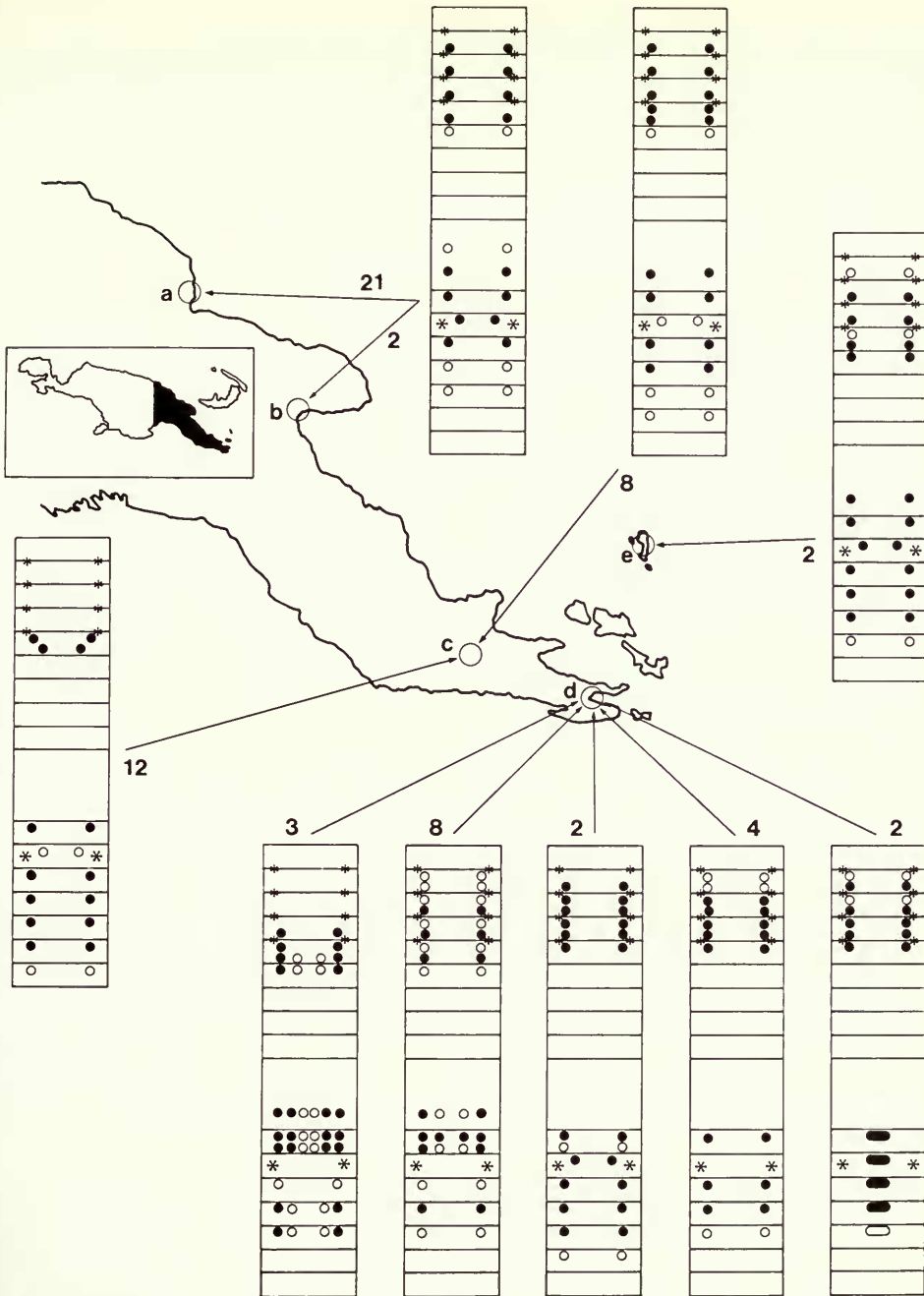


Fig. 38 *Metapheretima triciae* sp. nov. Ventral markings: geographical variations. (a) Madang (type locality); (b) Langemak Bay; (c) Mt Suckling; (d) Milne Bay; (e) Trobriand Islands. Numerals indicate numbers of clitellate individuals examined. Closed circles – markings invariably present; open circles – markings occasionally present.

Internal characters. Septa 5/6/7/8 thickened, 8/9/10 membranous or absent, 10/11–12/13 membranous. Oesophagus simple or with small, dorsolateral pouches in *x*. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs large paired, often joined above the intestine, in *xi*, seminal vesicles reaching the dorsolateral or dorsal line in *xii*. Pseudoseminal vesicles in *xiii*. Spermathecae (Fig. 32k) paired in *v–ix*.

DISTRIBUTION. East and northeast New Guinea.

REMARKS. The genital markings of this species are variable although usually constant in specimens from one locality. It has not been possible to establish any correlations between the many papillae patterns, the various distances separating the spermathecal pores and the conditions of the testes sacs; for convenience, therefore, populations possessing these variations are not separated taxonomically.

MATERIAL EXAMINED. 22C, 1A Waterlogged dark sandy loam with a high organic content, vegetation of ferns, grass and coconut, close to sea, Bunu village no 2, Madang district, Papua New Guinea, 4° 52' S, 145° 49' E, coll J W Copland 14 Nov 1971; BMNH 1976.3.130–154 (syntypes of *triciae*). 12C, 8A Data as above; BMNH 1977.1.153–172. 15C, 18A Mau 1, Mt Suckling, Papua New Guinea, coll W H Ewers Jun 1972; BMNH 1976.4.7–29, 68–81, 140. 15C, 8A Samarai, Milne Bay, Papua New Guinea, coll J W Copland 21 Jul 1971; BMNH 1977.1.173–194. 4A Sineada, Milne Bay, Papua New Guinea, coll J W Copland 22 Jul 1971; BMNH 1977.1.197–200. 2C, Trobriand Islands, Papua New Guinea, coll J W Copland; BMNH 1977.1.195–196. 3C, 1A Papua New Guinea (label completely destroyed), coll J W Copland; BMNH 1977.1.201–204. 2C, 1 posterior fragment, rotting stems of wood at waterfall Langemak Bay, east Coast, Papua New Guinea; Hamburg 01.13177 (specimens separated from type series of *M. pallens* (Ude, 1932)).

Metapheretima trukensis (Ohfuchi, 1940)

Pheretima trukensis Ohfuchi, 1940 : 24.

Metapheretima trukensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; closely paired spermathecal pores in furrows 5/6/7/8.

DESCRIPTION. *External characters.* Length 189–193 mm, diameter 6.7–7.3 mm. 130–135 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae 36–38 on *vii*, 75–80 on *xx*, details of setal ring not recorded.

Male pores 'minute' on conical papillae or circular porophores (Ohfuchi, 1940 was unable to detect which of the structures on *xviii* carried the male pores), separation not recorded. Female pores not recorded. Spermathecal pores paired in 5/6/7/8, *c.* 0.10 body circumference apart.

Genital markings (Fig. 39a) several paired markings, presetal on *xix–xxi*, postsetal on *xvii*, *xviii*.

Internal characters. Septa 5/6/7 thickened, 8/9/10 absent, 10/11–14/15 thickened. Intestinal origin *xx*. Lateral hearts not recorded. Holandric; testes sacs annular, *x*, *xi* seminal vesicles small, *xii*. Spermathecae (Fig. 32l) paired in *vi–viii*. Description after Ohfuchi (1940).

DISTRIBUTION. Truk, east Carolines.

REMARKS. This species has been assigned to the genus *Metapheretima* on the affinities revealed during the numerical studies (see above), since it is uncertain whether the intersegmental genital markings associated with the male pores are crescentic genital markings. *M. trukensis* possesses several morphological features atypical of the genus. There are two pairs of presetal genital markings and the intestine begins in *xx*.

RECORDS. 3 or more specimens Natsushima of Truk, east Carolines Islands (syntypes of *trukensis*).

Metapheretima carolinensis (Michaelsen, 1910)

Pheretima carolinensis Michaelsen, 1910b : 105; Ohfuchi, 1940 : 7.

Pheretima (*Polypheretima*) *carolinensis*: Michaelsen, 1934b : 15.

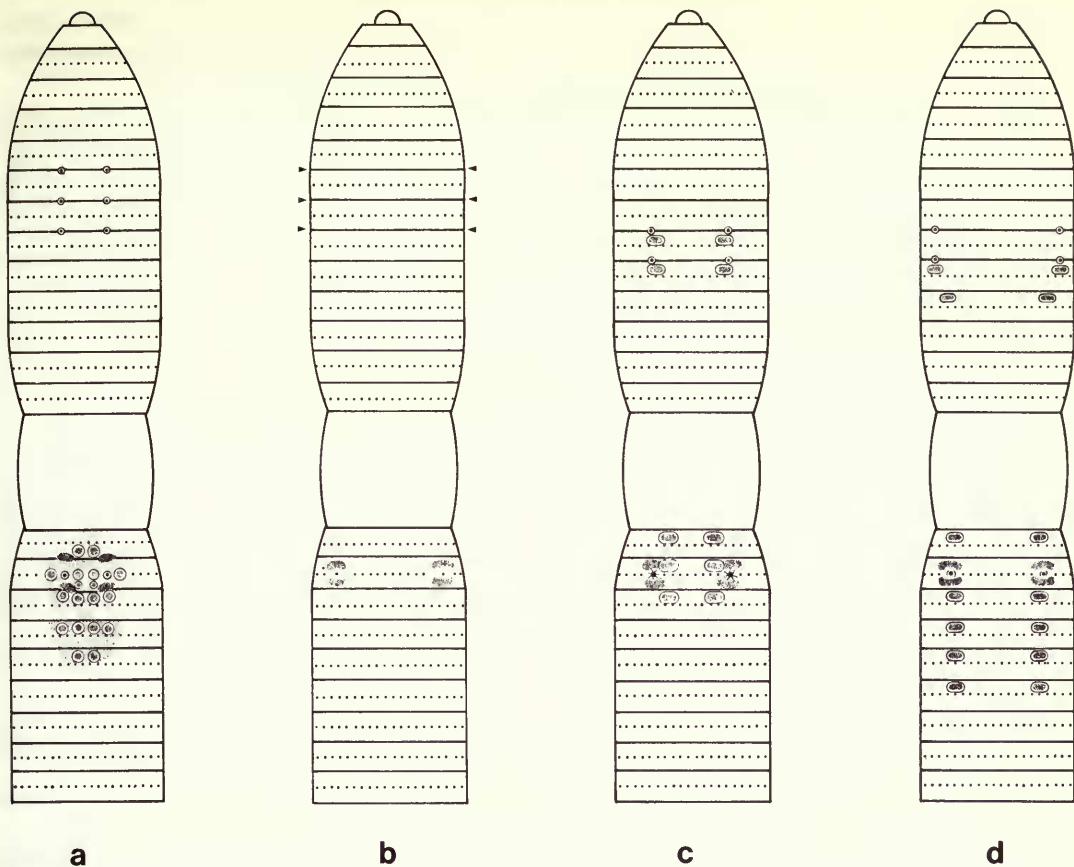


Fig. 39 Anterior ventral surface, diagnostic characters. (a) *Metapheretima trukensis*; (b) *M. carolinensis*, arrows indicate furrows with numerous dorsal spermathecal pores; (c) *M. sembaluensis*; (d) *M. pallens*.

Metapheretima carolinensis: Sims & Easton, 1972 : 233.

Pheretima garama Gates, 1958 : 8.

Metapheretima garama: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; numerous, dorsally placed spermathecal pores in furrows 5/6/7/8.

DESCRIPTION. *External characters*. Length 47–191 mm, diameter 3–7 mm. 86–134 segments. Clitellum *xiv*–*xvi*. First dorsal 11/12 or 12/13. Setae, 33–53 on *vii*, 57–70 on *xx*, setal ring regular with dorsal gaps on postclitellar segments ($aa = ab = yz = 0.5zz$).

Male pores simple, $c. 0.26$ body circumference apart. Female pore single. Spermathecal pores small transverse slits, numerous in paired batteries in 5/6/7/8, $c. 0.90$ body circumference apart.

Genital markings, absent apart from those diagnostic of the genus (Fig. 39b).

Internal characters. Septa 5/6/7/8 thickened, 8/9/10 absent, 10/11–14/15 thickened. Intestine begins in *xv*. Lateral hearts in *x*–*xii*.

Holandric, testes sacs paired, extending to the lateral line in *x* and to the dorsal line in *xi*, seminal vesicles of *xi* extending to the lateral line and enclosed in the testes sacs, those of *xii* extending to the dorsal line. Pseudoseminal vesicles in *xiv*. Spermathecae (Fig. 32m) paired batteries of up to 8 spermathecae in *vi*–*viii*.

DISTRIBUTION. Caroline Islands.

REMARKS. The original description of *M. garama* differs from the type series of *carolinensis* only by its smaller size and lower setal numbers. These differences do not appear to be taxonomically significant.

MATERIAL EXAMINED. 2C Caroline Islands; Hamburg v3310 (syntypes of *carolinensis*). 1C Tokongo Islet, Kapingamarangi, south Caroline Islands; New York 3569 (holotype of *garama*). The original description of *garama* was based on a further 6C and 9A paratypes; their present location is unknown.

OTHER RECORDS. 8 specimens Angaul Island, Caroline Islands (*carolinensis*: Ohfuchi, 1940).

Metapheretima sembaluensis (Ude, 1932)

Pheretima (*Pheretima*) *sembaluensis* Ude, 1932 : 139.

Metapheretima sembaluensis: Sims & Easton, 1972 : 233.

Pheretima (*Pheretima*) *rosai* Ude, 1932 : 140.

Metapheretima rosai: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one fifth of the body circumference apart in furrows 7/8/9. Holandric. Spermathecal diverticula simple, ectal.

DESCRIPTION. *External characters*. Length 100–210 mm, diameter 4–8 mm. 140–150 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12 or 12/13. Setae, 60–120 on *vii*, 70–80 on *xx*, setal ring regular ($aa = ab = yz = zz$).

Male pores, large, simple, *c*. 0.20 body circumference apart. Female pore single. Spermathecal pores large, paired in 7/8/9, *c*. 0.20 body circumference apart.

Genital markings (Fig. 39c) paired, presetal, slightly median to the line of the spermathecal pores, on *viii* and *ix*, slightly median to the male pores, on *xvii–xx*, the pair of markings on *xviii* may be fused to form a single median marking.

Internal characters. Anterior septa present and thickened. Intestine begins in *xv*. Lateral hearts in *x–xii* and occasionally *xiii*.

Holandric, testes sacs small, paired, ventral in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*. Pseudoseminal vesicles large in *xiii*. Spermathecae (Fig. 32n) paired in *viii–ix*.

DISTRIBUTION. Lombok.

REMARKS. Ude (1932) described *sembaluensis* and *rosai* on material from Lombok with single (median) and paired genital markings respectively in the region of the male pores. More recently collected series exhibit a tendency for the paired genital markings to meet and coalesce to form a single median marking, on this evidence it is proposed to synonymize the two taxa.

M. sembaluensis is the only known species of *Metapheretima* occurring in Lombok where it represents the most westerly record of the genus.

MATERIAL EXAMINED. *New records*. 4A, 1A Surawadi, Lombok, 400 m, coll G Lincoln 10 Aug 1973; BMNH 1975.7.15–18. 7C, 1A Bentak halfway between Tandjung and Mataram, Lombok 400 m, coll G Lincoln 12–13 Aug 1973; BMNH 1975.7.19–27.

OTHER RECORDS. Plateau enclosed by crater wall, Rinjani district, Sembalun, Lombok, 1200 m (type(s) of *sembaluensis*). Lake Tihoe, Ladjang, Lombok (type(s) of *rosai*).

Metapheretima pallens (Ude, 1932 : 170)

Pheretima (*Metapheretima*) *pallens* Ude, 1932 : 170.

Metapheretima pallens: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one third of the body circumference. Metandric. Spermathecal diverticula simple.

DESCRIPTION. *External characters*. Length 38–130 mm, diameter 4–5 mm. 90–102 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12. Setae, 146–156 on *vii*, 25–30 on *xx*, setal ring regular

on preclitellar segments ($aa=ab=yz=zz$), slightly crowded ventrally with ventral gaps on postclitellar segments ($aa=2ab=yz=zz$).

Male pores small transverse slits, *c.* 0.21 body circumference apart. Female pores single. Spermathecal pores large, paired in 7/8/9, *c.* 0.31 body circumference apart.

Genital markings (Fig. 39d) paired, presetal, directly posterior to the spermathecal pores on *viii* and *ix*, more medianly placed on *x* and *xi*, in line with the male pores on *xvii*, *xx-xxv*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 absent, 9/10 membranous, 10/11 absent, 11/12/13/14 membranous. Oesophagus with paired dorsal pouches in *x-xi*. Intestine begins in *xvi*. Lateral hearts in *xi-xiii*.

Metandric, testes sacs small, paired, reaching the lateral line in *xi*, seminal vesicles extending to the dorsal line in *xii*. Pseudoseminal vesicles small in *xiv*. Spermathecae (Fig. 32o) paired in *viii-ix*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. *Previously reported.* 2C, 11A From rotting stems in woodland near waterfall, Langemak bay, east coast, Papua New Guinea; Hamburg v3482 (syntypes of *pallens*). This series was contained in a jar with a museum label on which was written a manuscript name '. . . n. sp. Ude, 1926'. On examination the specimens were found to form two series. The first one agrees closely with the description of *M. pallens*, and since the collecting details also agree with those provided by Ude (1932) the material can be regarded as the hitherto missing type series of the species. The specimens forming the second series are described above under the name *M. triciae*. *New records.* 10C Very wet black soil, Woitape Station, Goilala, Papua New Guinea, 1600 m, coll J W Copland; BMNH 1977.1.50-59. 2C Side of creek, Faripe road, Woitape, Goilala, Papua New Guinea, 1850 m, coll J W Copland; BMNH 1977.1.47-49. 2C, 2A Guarimeipa, Papua New Guinea, 1500 m, coll J W Copland 7 Dec 1973; BMNH 1977.1.43-46. 11C, 6A Umboli, Papua New Guinea, 1800-2400 m, coll Griffiths 1972; BMNH 1976.10.1.18.

Metapheretima neoguinensis species-group

DIAGNOSIS. *Metapheretima* with simple male pores lacking associated glandular ridges. Spermathecal diverticula multilocular, ectal.

SPECIES INCLUDED. *deirdrae*, *loriae*, *neoguinensis*, *septocta*, *sucklingensis*.

DISTRIBUTION. South-east New Guinea, New Britain, ? Solomon Islands.

REMARKS. The species forming the *neoguinensis* species-group are readily distinguished from one another by the distribution of their spermathecal pores; *loriae*, 4/5/6/7/8/9; *neoguinensis*, 5/6/7/8/9; *sucklingensis*, 6/7/8/9; *deirdrae*, 7/8/9 and *septocta*, 7/8. All of the members of this species-group are metandric but in view of the low information value of metandry in other species-groups of *Metapheretima*, this character is not regarded as being diagnostic of the group.

Metapheretima loriae (Rosa, 1898)

Perichaeta loriae Rosa, 1898b : 61; ? Beddard, 1899 : 185 (? = *M. pickfordi*).

Amyntas loriae: Beddard, 1900a : 641.

Pheretima loriae: Michaelsen, 1900 : 281; Ude, 1905 : 481.

Metapheretima loriae: Sims & Easton, 1972 : 231.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one quarter of the body circumference apart in furrows 4/5/6/7/8/9. Metandric. Spermathecal diverticula multilocular, ectal.

DESCRIPTION. *External characters.* Length 120-130 mm, diameter *c.* 6 mm. *C.* 99 segments. Clitellum *xiv-xvi*. First dorsal pore 11/12 or 12/13. Setae, 51-63 on *vii*, 52-60 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), slightly crowded ventrally on postclitellar segments ($aa=ab=0.5yz=0.5zz$).

Male pores simple, 0.14–0.20 body circumference apart. Female pores paired. Spermathecal pores small, paired in 4/5/6/7/8/9, 0.20–0.28 body circumference apart.

Genital markings (Fig. 40a) paired, presetal, slightly median to the line of the spermathecal pores, on *viii* and *ix*, slightly median to the male pores on *xvii*, *xix* and *xx*.

Internal characters. Septa 5/6–11/12 membranous, 12/13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x–xiii*.

Metandric, testes sacs small, paired in *xi*, seminal vesicles large, reaching to the dorsal line in *xii*. Spermathecae (Fig. 33a) paired in *v–ix*, diverticula multilocular.

DISTRIBUTION. New Guinea, ? Solomon Islands.

REMARKS. The record of *loriae* from the Solomon Islands (Beddard, 1899) is dubious since there is no reference to the presence of the diagnostic multilocular spermathecal diverticula; unfortunately this material cannot be located. It is more likely that Beddard's material was of the species *M. pickfordi* which is known only from the Solomon Islands, has only simple spermathecal diverticula and is probably metandric.

MATERIAL EXAMINED. *Previously reported.* 2C, 1A 'Hughibagu', Papua New Guinea; Genova 37 (syntypes of *loriae*). This locality cannot be traced, possibly the name is a corruption of Hughes Bay, Fergusson Islands, 9° 23' S, 150° 42' E, which is near other places visited by the same collector.

New record. 1C Mt Suckling, Papua New Guinea, coll W H Ewers 15 Jun 1972; BMNH 1976.4.3.

OTHER RECORDS. 2 specimens, Guadalcanal, Solomon Islands (*loriae*: Beddard, 1899).

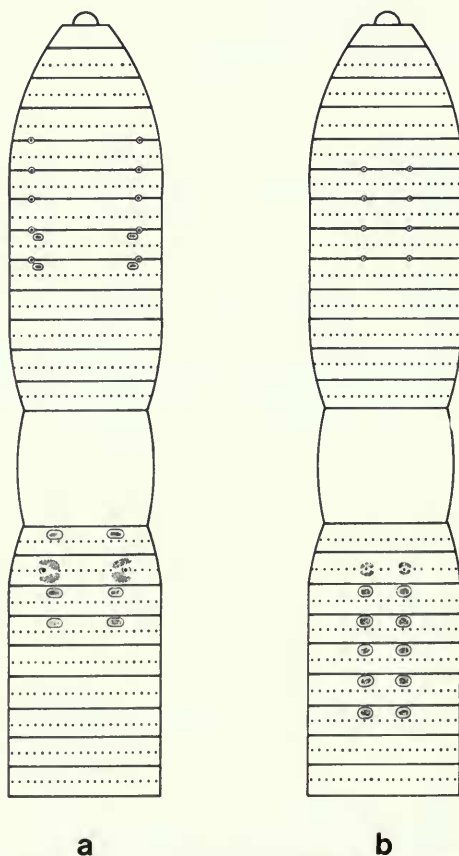


Fig. 40 Anterior ventral surface, diagnostic characters. (a) *Metapheretima loriae*; (b) *M. neoguineensis*.

Metapheretima neoguinesis (Michaelsen, 1892)

Perichaeta neoguinesis Michaelsen, 1892 : 299.

Amyntas neoguinesis (part, i.e. acaecate specimens) : Beddard, 1900a : 642.

Pheretima neoguinesis : Michaelsen, 1900 : 288; Ude, 1905 : 481; (syn. *helvola*) Ude, 1932 : 173.

Pheretima (*Metapheretima*) *neoguinesis* : Michaelsen, 1928a : 7.

Metapheretima neoguinesis : Sims & Easton, 1972 : 205, 233.

Pheretima helvola Ude, 1905 : 473 [non Michaelsen, 1934c : 520 (= *Metaphire hobaensis* Gates, 1941)].

Metapheretima helvola : Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores less than one tenth of the body circumference apart in furrows 5/6/7/8/9. Metandric. Spermathecal diverticula multilocular, ectal.

DESCRIPTION. *External characters*. Length 140–150 mm, diameter 6–9 mm. 94–124 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13 or 13/14. Setae, 78–98 on *vii*, 66–86 on *xx*, setal ring regular with dorsal and ventral gaps on postclitellar segments ($aa = 1.5ab = 1.5yz = zz$).

Male pores simple, 0.06–0.12 body circumference apart. Female pore paired or single. Spermathecal pores small, paired, in 5/6/7/8/9, 0.02–0.08 body circumference apart.

Genital markings (Fig. 40b) paired, presetal in line with the male pores on *xix–xxiii*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 membranous, 9/10 membranous or absent, 10/11–13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x–xiii*.

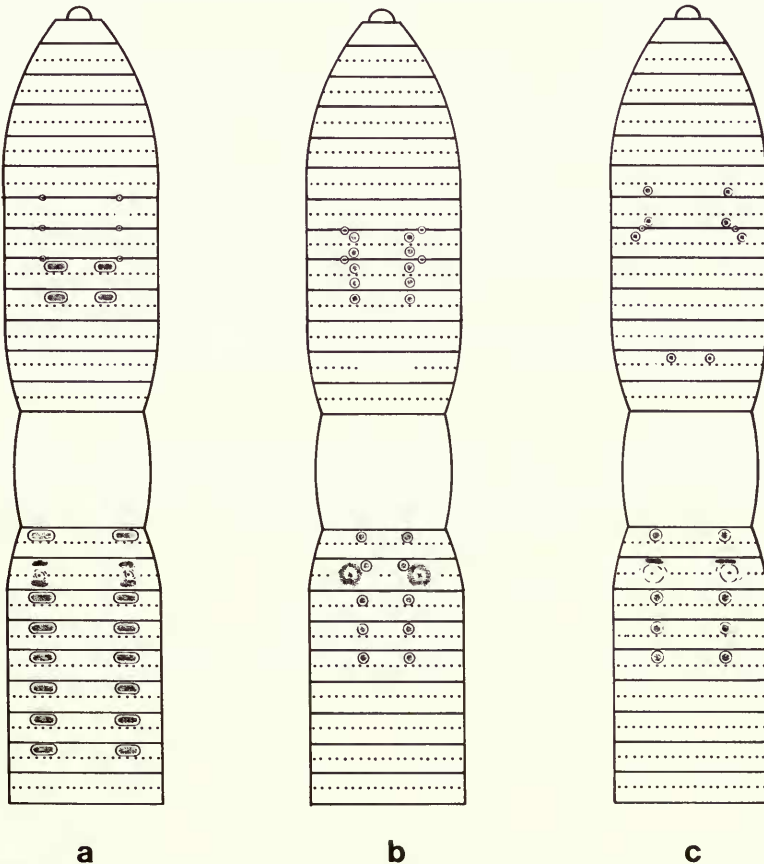


Fig. 41 Anterior ventral surface, diagnostic characters. (a) *Metapheretima sucklingensis* sp. nov.; (b) *M. dierdrae* sp. nov.; (c) *M. septocta*.

Metandric, testes sacs small, paired, ventral in *xi*, seminal vesicles large, extending to the dorsal line in *xii*. Pseudoseminal vesicles vestigial in *xiii* or absent. Spermathecae (Fig. 33b) paired in *vi-ix*, diverticula multilocular.

DISTRIBUTION. New Guinea, New Britain.

REMARKS. Rosa (1898) described *spectabilis* as a variety of *neoguineensis* but Beddard (1900a) placed them together in synonymy. Michaelsen (1900) restricted the definition of *neoguineensis* and recognized *spectabilis* as a distinct species which Sims & Easton (1972) assigned to the genus *Amyntas*.

The type series of *helvola* could not be located during the preparation of this report so it has not been possible to evaluate Ude's decision (1932) to place this species within the synonymy of *neoguineensis*.

MATERIAL EXAMINED. *Previously reported*. 1C New Guinea; Hamburg v332 (syntype of *neoguineensis*). 2C New Guinea; Berlin 2133 (syntypes of *neoguineensis*).

New record. 1C, 2A Port Moresby, Papua New Guinea, coll W E Ewer Apr 1967; BMNH 1976.4.4-6.

OTHER RECORDS. Ralum, New Britain (type(s) of *helvola* Ude, 1905).

Metapheretima sucklingensis sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one quarter of the body circumference apart in furrows 6/7/8/9. Metandric. Spermathecal diverticula multilocular, ectal.

DESCRIPTION. *External characters*. Length *c.* 175 mm, diameter *c.* 6 mm. *C.* 160 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae 51-76 on *vii*, 53-57 on *xx*, setal ring regular with dorsal and ventral gaps ($aa=2ab=2yz=zz$).

Male pores simple on small spherical porophores 0.23-0.28 body circumference apart. Female pores paired. Spermathecal pores small, paired in 6/7/8/9, *c.* 0.16-0.33 body circumference apart.

Genital markings (Fig. 41a), paired, presetal, median to the line of the spermathecal pores on *ix* and *x*, in line with the male pores on *xvii*, *xix-xxiv*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 absent, 9/10-12/13 thickened. Oesophagus slightly pouched in *x*, *xi*. Intestine begins in *xv*. Lateral hearts in *x-xii*.

Metandric, testes sacs small, paired, ventral in *xi*, seminal vesicles extending to the dorsal line in *xii*. Pseudoseminal vesicles vestigial in *xiv*. Spermathecae (Fig. 33c) paired in *vii-ix*, diverticula multilocular.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 2C, 1A Mt Suckling, Papua New Guinea, 9° 46' S, 149° 00' E, coll W H Ewer 1972; BMNH 1976.4.64-66 (syntypes of *sucklingensis*). 1C In large bunches of fruits of *Fucus* sp., close to ground, Mt Suckling, Papua New Guinea, coll G Leach 5 Jul 1972; BMNH 1976.4.67.

Metapheretima deirdrae sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one fifth of the body circumference apart in furrows 7/8/9. Metandric. Spermathecal diverticula multilocular, ectal.

DESCRIPTION. *External characters*. Length 180-210 mm, diameter 5-7 mm. 250-259 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, *c.* 110 on *vii*, *c.* 88 on *xx*, setal ring regular ($aa=ab=yz=zz$).

Male pores large, each surrounded by an annulus of pigmented epidermis, *c.* 0.14 body circumference apart. Female pores paired. Spermathecal pores large, paired in 7/8/9, *c.* 0.19 body circumference apart.

Genital markings (Fig. 41b) paired, pre- and postsetal on *vii-x*, slightly median to the line of the spermathecal pores, presetal slightly median to the male pores on *xvii-xxi*.

Internal characters. Septa 5/6-7/8 thickened, 8/9 membranous, 9/10-13/14 membranous. Intestine begins in *xv*. Lateral hearts in *x-xiii*.

Metandric, testes sacs small, paired extending to the lateral line in *xi*, seminal vesicles in *xii*. Spermathecae (Fig. 33d) paired in *viii* and *ix*, diverticula multilocular.

DISTRIBUTION. New Guinea.

REMARKS. The crescentic markings diagnostic of the genus *Metapheretima* are apparently absent from the type series of this species although the annuli of pigmented epidermis surrounding the male pores may represent a modified form of these markings. The species has many affinities with other members of the *Metapheretima neoguineensis* species group including the presence of multilocular spermathecal diverticula.

MATERIAL EXAMINED. 2C, 3A Slope in sun with only a little vegetation, Lavavai, Papua New Guinea 8° 23' S, 147° 03' E, 1600 m, coll J W Copland; BMNH 1977.1.4-8 (syntypes of *deirdrae*).

Metapheretima septocta sp. nov.

DIAGNOSIS. *Metapheretima* with simple male pores; paired spermathecal pores about one fifth of the body circumference apart in furrow 7/8. Metandric. Spermathecal diverticula multilocular, ectal.

DESCRIPTION. *External characters.* Length *c.* 103 mm, diameter *c.* 4 mm. C. 112 segments. Clitellum *xiv-xvi*. First dorsal pore 12/13. Setae, *c.* 43 on *vii*, *c.* 46 on *xx*, setal ring regular with ventral gaps on preclitellar segments ($aa = 2ab = 2yz = 2zz$), with dorsal and ventral gaps on postclitellar segments ($aa = 2ab = 2yz = zz$).

Male pores small transverse slits on spherical porophores, *c.* 0.19 body circumference apart. Female pore single. Spermathecal pores small paired transverse slits in 7/8, *c.* 0.22 body circumference apart.

Genital markings (Fig. 41c), paired, presetal on *viii*, lateral to the spermathecal pores and on *xii* median to the spermathecal pores, postsetal on *vi* and *vii* median to the spermathecal pores, presetal on *xvii*, *xix-xxi* slightly median to the male pores.

Internal characters. Septa 5/6/7/8 thickened, 8/9 absent, 9/10-13/14 slightly thickened, intestine begins in *xvi*. Lateral hearts in *x-xiii*.

Metandric, testes paired, extending to the lateral line in *xi*, seminal vesicles large, extending to the dorsal line in *xii*. Spermathecae (Fig. 33e) paired in *viii*, diverticula multilocular.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 8C Mt Suckling, Papua New Guinea, 9° 46' S, 149° 00' E, coll W H Ewer Jun 1972; BMNH 1976.4.55-62 (syntypes of *septocta*).

Metapheretima durendali species-group

DIAGNOSIS. *Metapheretima* with male pores on penes within copulatory pouches; large paired spermathecal pores, usually in several furrows. Spermathecal diverticula simple, ectal in origin. Glandular ridges associated with the male pores absent.

SPECIES INCLUDED. *durendali*, *excalaberi*.

DISTRIBUTION. New Guinea.

REMARKS. Although members of this group and the *oinakensis* species-group closely resemble one another, *durendali* and *excalaberi* may be distinguished externally by their more numerous, anteriorly situated spermathecal pores and internally by the ectal origin of the spermathecal diverticula.

M. durendali and *excalaberi* are sympatric and morphologically similar. Nevertheless, each may be recognized on the distribution and separation of the spermathecal pores, separation of the

male pores, and arrangement of the genital markings (differences in size and setal numbers are insignificant). The variations in the distinguishing characters are listed in Table 14.

Table 14 Character variation in the *Metapheretima durendali* species-group

Character	<i>durendali</i>	<i>excalaberi</i>
Spermathecal furrows	4/5/6/7/8 5/6/7/8 6/7/8 6/7	4/5/6
Separation of spermathecal pores	0.22	0.30
Separation of male pores	0.16	0.22
Preclitellar genital markings	<i>xi, xii</i>	<i>ix, xi-xiii</i>
Postclitellar genital markings	<i>xvii, xix-xxiii</i>	<i>xvii, xix</i>

Of the five samples examined, *durendali* and *excalaberi* were found together in four in which the proportion of individuals of the two species present varied. It is not possible to establish a correlation between the relative population densities of the species and any of the ecological data. Details of the ecological data and the numbers of specimens collected at each locality are given in Table 15.

Table 15 Proportions of *Metapheretima durendali* and *M. excalaberi* found at various localities

Locality	<i>excalaberi</i> (all 4/5/6)	<i>durendali</i> (thecal types, 4/5/6/7/8: 6/7/8: 6/7: athecate)
Gentle ridge		
0-15 cm (K440)	13 ¹	4 (0: 1 ² : 1: 2)
0-15 cm (K491)	3	11 (10: 0: 0: 1)
Wet gully		
0-15 cm (K530)	24	21 ¹ (7: 1: 3: 10)
15-25 cm (K547)	1	0
0-30 cm (K561)	1	26 (26: 0: 0: 0)

¹ Indicate type series.

² The spermathecal pores of this individual were in furrows 5/6 (right side only), 6/7 (left side only) and 7/8 (both right and left sides).

Metapheretima excalaberi sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on penes within copulatory pouches; paired spermathecal pores about one third of the body circumference apart in furrows 4/5/6. Holandric.

DESCRIPTION. *External characters.* Length *c.* 38 mm, diameter *c.* 2 mm, *C.* 115 segments. Clitellum *xiv-xvi*. First dorsal pore 11/12. Setae, 40-46 on *vii*, 30-35 on *xx*, setal ring regular (*aa = ab = yz = zz*).

Male pores on short slim penes within shallow copulatory pouches, *c.* 0.22 body circumference apart. Female pore single. Spermathecal pores large, paired in 4/5/6, *c.* 0.30 body circumference apart.

Genital markings (Fig. 42a), large, paired, presetal slightly median to the line of the male pores on *xvii, xix*; slightly median to the spermathecal pores on *ix, xi-xiii*.

Internal characters. Septa 5/6/7/8 thickened, 8/9 absent, 9/10–13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x–xiii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles paired, extending to the dorsal line in *xi* and *xii*, those of *xi* enclosed in the testes sacs. Pseudoseminal vesicles absent. Spermathecae (Fig. 33f) paired in *v* and *vi*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 8C, 5A Top 15 cm of alluvial clay derived from gabbro, pH 5.5–6.3, highly humidified, organic content 15–30%, C/N ratio 8–9, gentle ridge with mixed lower montane forest, *Podocarpus*, Eleocarpaceae, Lauraceae, Cumoniaceae dominant, Bismarck range, Eastern Highland district, Papua New Guinea, 5° 57' S, 145° 15' E, rainfall 890 cm/year, altitude 2500 m, coll D R Kershaw 14 Jul 1971; BMNH 1976.5.75–87 (syntypes of *excalaberi*). 29C Locality and collector as above; BMNH 1976.5.88–115.

Metapheretima duren dali sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on penes within copulatory pouches; paired spermathecal pores about one fifth of the body circumference apart in furrows (4/5/6) 6/7 (7/8). Holandric.

DESCRIPTION. *External characters.* Length *c.* 30 mm, diameter *c.* 2 mm. *C.* 100 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12. Setae 31–43 on *vii*, 35–47 on *xx*, setal ring regular ($aa=ab=yz=zz$).

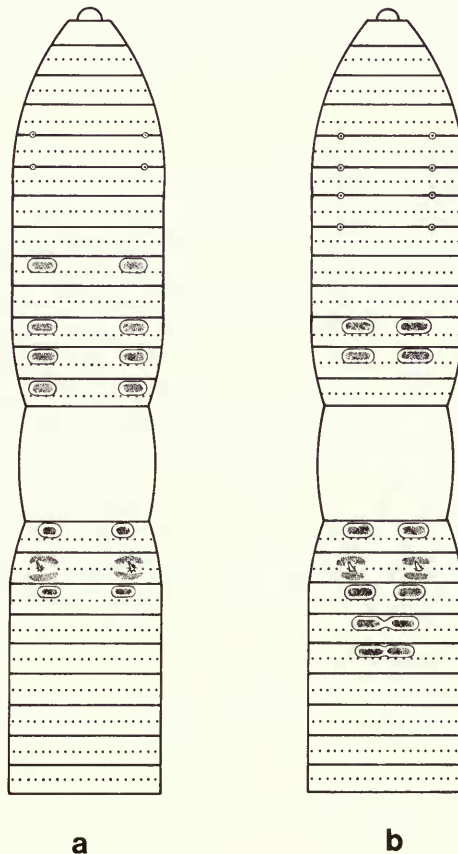


Fig. 42 Anterior ventral surface, diagnostic characters. (a) *Metapheretima exalaberi* sp. nov.; (b) *M. duren dali* sp. nov.

Male pores on short, slim penes within shallow copulatory pouches, *c.* 0.16 body circumference apart. Female pore single. Spermathecal pores large, paired in 4/5/6/7/8, rarely 5/6/7/8, 6/7/8 or 6/7, *c.* 0.22 body circumference apart.

Genital markings (Fig. 42b) large paired, presetal slightly median to the line of the male pores on *xvii*, *xix-xxii*; slightly median to the spermathecal pores on *xi*, *xii*.

Internal characters. Septa 5/6-7/8 slightly thickened, 8/9 absent, 9/10-13/14 thickened. Intestine begins in *xv*. Lateral hearts in *x-xiii*.

Holandric, testes sacs paired, extending to the dorsal line in *x* and *xi*, seminal vesicles paired, extending to the dorsal line in *xi* and *xii*, those of *xi* enclosed in the testes sacs. Spermathecae (Fig. 33g) paired, usually in *v-viii*, rarely in *vi-viii*, *vii-viii* or *vii* only.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 26C Top 30 cm of soil of alluvial clay derived from gabbro, pH 5.5-6.3, highly humidified, organic content 15-30%, C/N ratio 8-9, wet gully covered with mixed lower montane forest, *Podocarpus*, *Eleocarpaceae*, *Lauraceae* *Cumoniaceae* dominant, Bismarck range, Eastern Highland district, Papua New Guinea, 5° 57' S, 145° 15' E, rainfall 890 cm/year, altitude 2500 m, coll D R Kershaw 20 Jul 1971; BMNH 1976.5.30-65 (syntypes of *durendali*). 34C, 2A Data and collector as above; BMNH 1976.5.1-29, 66-74.

Metapheretima oinakensis species-group

DIAGNOSIS. *Metapheretima* with male pores on penes, usually within copulatory pouches; large paired, spermathecal pores in one or two furrows. Spermathecal diverticula simple, ectal in origin. Glandular ridges usually associated with the male pores.

SPECIES INCLUDED. *andurili*, *dorii*, *glamdringi*, *kilii*, *oinakensis*, *orcrista*, *parmata*, *stingi*, *tawarinensis*.

DISTRIBUTION. New Guinea.

REMARKS. *M. andurili* may be readily distinguished from the other members of this species-group by the occurrence of the spermathecal pores in furrow 5/6 and occasionally 6/7, instead of in furrow 7/8 only. Marker characters for the recognition of the species with spermathecal pores in furrow 7/8 only are given in Table 16.

Table 16 Marker characters of the members of the *Metapheretima oinakensis* species-group with spermathecal pores in furrow 7/8 only

Species	Separation of spermathecal pores	Copulatory pouches	Glandular ridges	Other genital markings		Testes
				Presetal	Postsetal	
<i>tawarinensis</i>	0.16	absent	<i>xvii</i> only	<i>vii, x, xix, xx</i>	<i>xvii</i>	Holandric
<i>kilii</i>	0.20	absent	?	<i>xix</i>	<i>xvii</i>	Metandric
<i>dorii</i>	0.37	absent	?	-	<i>xvii, xix, xxiv</i>	Metandric
<i>stingi</i>	0.12	present	absent	<i>xix, xx</i>	<i>xvii</i>	Holandric
<i>oinakensis</i>	0.25	present	absent	<i>ix-xiii, xvii, xix-xxii</i>	-	Holandric
<i>orcrista</i>	0.07	present	<i>xvii-xix</i>	<i>x</i>	-	Holandric
<i>parmata</i>	'closely paired'	?	<i>xvii-xx</i>	-	-	Holandric
<i>glamdringi</i>	0.18	present	<i>xviii</i> only	<i>xvii, xix, xx</i>	<i>ix</i>	Proandric

Metapheretima tawarinensis (Cognetti, 1911)

Pheretima tawarinensis (sic) Cognetti, 1911 : 2.

Pheretima tawarinensis: Cognetti, 1912 : 543.

Metapheretima tawarinensis: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with simple male pores on short penes; large spermathecal pores about one sixth of the body circumference apart in furrow 7/8. Holandric. Spermathecal diverticula simple and ental.

DESCRIPTION. *External characters.* Length 15–130 mm, diameter 1.5–3 mm. 73–121 segments. Clitellum *xiii–xvi*. First dorsal pore 11/12 or 12/13. Setae, 38–82 on *vii*, 34–40 on *xx*, setal ring regular with ventral gaps on postclitellar segments ($aa=2ab=2yz=2zz$).

Male pores on short, stout penes not incorporated in copulatory pouches, *c.* 0.16–0.18 body circumference apart. Female pores paired. Spermathecal pores large in 7/8, *c.* 0.14–0.16 body circumference apart.

Genital markings (Fig. 43a) large, paired presetal on *x* or occasionally *viii*, in line with the spermathecal pores, paired, presetal on *xix*, *xx* and rarely more posterior segments, postsetal on *xvii*, in line with the male pores. The presetal region of *xvii* is elevated to form a ridge similar to that found in *Metapheretima kilii* and *M. dorii*.

Internal characters. Septa 5/6/7/8 slightly thickened, 8/9/10 absent, 10/11/12/13 slightly thickened. Intestine begins in *xv*. Lateral hearts in *x–xiii*.

Holandric, testes sacs small, paired, ventral in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*. Spermathecae (Fig. 33h) paired in *viii*.

DISTRIBUTION. New Guinea.

REMARKS. The descriptions of this species provided by Cognetti (1911, 1912) were based on the examination of a single clitellate specimen 15 mm long which lacked genital markings. Because of the poor condition of the holotype Cognetti was unable to determine the beginning of the intestine, whether the species possessed intestinal caeca, the positions of the lateral hearts or the condition of the anterior male reproductive system. The new specimens have been identified as this species on the basis of the long clitellum, shape of spermathecae and the separation of the male and spermathecal pores.

MATERIAL EXAMINED. *Previously reported.* 1C Tawarin, New Guinea; Amsterdam Vol. 308 (holotype of *tawarinensis*).

New records. 1C, 1A Kaironk valley, Schrader range, Papua New Guinea, 1750 m, coll R N H Bulmer; BMNH 1976.2.68–69. 1C, 1A Webag, Western Highlands, Papua New Guinea, coll J W Copland; BMNH 1976.3.402–3. 12C Bismarck range, Eastern Highland district, Papua New Guinea, 2500 m, coll D R Kershaw 1971; BMNH 1976.5.184–188, 195–204.

Metapheretima kilii sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on penes; large paired spermathecal pores about one fifth of the body circumference apart in furrow 7/8. Metandric. Spermathecal diverticula simple and ental. Male genital field as Fig. 43b.

DESCRIPTION. *External characters.* Length 300 to over 335 mm, diameter 9–10 mm. *C.* 253 segments. Clitellum *xiv–xvi*. First dorsal pore 13/14. Setae, *c.* 265 on *vii*, *c.* 200 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), slightly crowded ventrally on postclitellar segments ($2aa=2ab=yz=zz$).

Male pores on stout penes *c.* 0.20 body circumference apart. Female pores paired. Spermathecal pores paired, large transverse slits in 7/8, *c.* 0.20 body circumference part.

Genital markings (Fig. 43b) closely paired, postsetal on *xvii*, presetal on *xix*.

Internal characters. Septa 5/6/7/8 thickened, 8/9/10 absent, 10/11–13/14 membranous. Oesophagus with paired, slight dorsolateral pouches in *xi*. Intestine begins in *xvi*. Lateral hearts in *x–xiii*.

Metandric, testes sacs small, paired, spherical, lateromedian in position, in *xi*, seminal vesicles large, reaching the dorsal line in *xii*. Copulatory pouches absent. Spermathecae (Fig. 33i) paired in *viii*.

DISTRIBUTION. New Guinea.

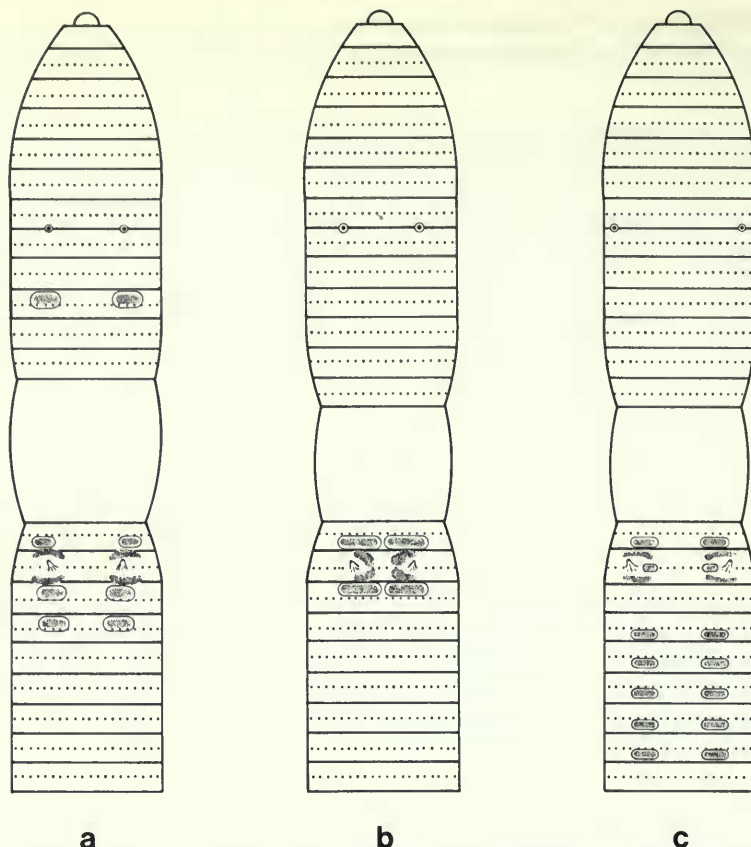


Fig. 43 Anterior ventral surface, diagnostic characters. (a) *Metapheretima tawarinensis*; (b) *M. kilii* sp. nov.; (c) *M. dorii* sp. nov.

MATERIAL EXAMINED. 2C, 1A Moist, dense mixture of peat and soil, very rich in humus, Land Resettlement Scheme (area drained 3 years prior to collection), Kendig, Mt Hagen district, Western Highlands, Papua New Guinea, $5^{\circ} 48' S$, $144^{\circ} 26' E$, coll J W Copland 15 Nov 1971; BMNH 1976.3.33–35 (syntypes of *kilii*). 31A Dark sandy loam covered by light vegetation, 120–150 m above Nupa village, Bena Bena subdistrict, c 15 miles east of Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 12 Oct 1971; BMNH 1976.3.36–67. 1A Kaironk valley, Schrader range, Madang district, Papua New Guinea, 1750 m, coll R N H Bulmer 9 Nov 1973; BMNH 1976.2.70. 3C, 6A Bismarck range, Eastern Highlands, Papua New Guinea, 2500 m, coll D R Kershaw 14–20 Jul 1971; BMNH 157–165. 18A Nupa village, Bena Bena subdistrict, c. 15 miles east of Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 13 Nov 1971; BMNH 1977.1.15–32. 5A⁺ Locality as above, coll J W Copland 31 Aug 1971; BMNH 1977.1.33–37.

Metapheretima dorii sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on penes; paired spermathecal pores about one third of the body circumference apart in furrow 7/8. Metandric. Spermathecal diverticula simple and ental. Male genital field as Fig. 43c.

DESCRIPTION. *External characters*. Length c. 145, diameter c. 6 mm. C. 161 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, c. 174 on *vii*, c. 70 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$) with dorsal and ventral gaps on postclitellar segments ($aa=2ab=2yz=zz$).

Male pores on stout penes, *c.* 0.26 body circumference apart. Female pores paired. Spermathecal pores paired, large transverse slits in 7/8, *c.* 0.37 body circumference apart.

Genital markings (Fig. 43c) paired, slightly median to the male pores, postsetal on *xvii*, *xx–xxiv*. Setal on *xviii*.

Internal characters. Septa 5/6/7/8 thick, 8/9 absent, 9/10–13/14 membranous. Oesophagus with slight paired dorsal pouches in *xi*. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs small, spherical paired, lateroventral in position in *xi*, seminal vesicles large, elongate in *xii*. Pseudoseminal vesicles in *xiii*, vestigial, *xiv*, medium sized. Copulatory pouches absent. Spermathecae (Fig. 33j) paired in *viii*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 3C, 6A Moist dark loam of moderate–high organic content, sloping plot being prepared for Kau Kau, boundary of Wabag, Western Highlands, Papua New Guinea, 5° 28' S, 143° 40' E, altitude 2000–3000 m, coll J W Copland 16 Nov 1971; BMNH 1976.3.23.31 (syntypes of *dorii*). 1C Data and collector as above; BMNH 1976.3.32.

Metapheretima andurili sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on slim penes within copulatory pouches; large paired spermathecal pores one quarter to two fifths of the body circumference apart in furrow 5/6 and occasionally 6/7. Metandric, spermathecal diverticulum simple and ental in origin.

DESCRIPTION. *External characters.* Length 60–72 mm, diameter 3–4 mm. 64–79 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, 43–56 on *vii*, 40–65 on *xx*, setal ring regular (*aa = ab = yz = zz*).

Male pores on long slim penes within copulatory pouches 0.24–0.29 body circumference apart. Female pore(s) single or paired. Spermathecal pores large, paired in 5/6 and occasionally 6/7, 0.26–0.42 body circumference apart.

Genital markings (Fig. 44a), paired, presetal, median to the spermathecal pores on *vi*, median to the male pores on *xviii*, crescentic markings of *xviii* absent.

Internal characters. Septa 5/6–7/8 slightly thickened, 8/9/10 absent, 10/11–13/14 slightly thickened. Intestine begins in *xv*. Lateral hearts in *x–xii*.

Metandric, testes sacs small, ventral in *xi*, seminal vesicles large, trilobate, reaching the dorsal line in *xii*. Pseudoseminal vesicles vestigial in *xiii* and *xiv*. Copulatory pouches large, spherical invading the coelom of *xviii*, penes long and slender. Spermathecae (Fig. 33k) paired in *vi* and occasionally in *vii*.

DISTRIBUTION. South-east New Guinea.

REMARKS. The individual reported from Mt Suckling differs from the type series by the spermathecal pores being more closely paired, an additional pair of spermathecae opening into furrow 6/7, more numerous setae and the lack of genital markings. The absence of genital markings and the number of setae may be attributed to a different state of maturity but the differences in the spermathecal system may indicate that this specimen represents a separate taxon. In the absence of an adequate series of specimens it is not proposed to recognize these differences taxonomically.

None of the four individuals examined possesses the crescentic markings diagnostic of the genus but the form of the copulatory pouches and penes, spermathecal pores and spermathecal diverticula are consistent with those present in other members of the *Metapheretima oinakensis* species-group.

MATERIAL EXAMINED. 3C Sarari, Milne Bay, Papua New Guinea, 10° 36' S, 150° 39' E, coll J W Copland 21 Jul 1971; BMNH 1977.1.1–3 (syntypes of *andurili*). 1C Mt Suckling, Papua New Guinea, coll W H Ewer Jun 1972; BMNH 1976.4.1.

Metapheretima stingi sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on penes within copulatory pouches; paired spermathecal pores about one eighth of the body circumference apart in furrow 7/8. Holandric. Spermathecal diverticula simple and ental. Male genital field as Fig. 44b.

DESCRIPTION. *External characters.* Length 74–94 mm, diameter *c.* 2 mm. 126–128 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, 76–84 on *vii*, *c.* 40 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), with dorsal and ventral gaps on postclitellar segments ($aa=2ab=2yz=zz$).

Male pores on elongate lobate penes within shallow copulatory pouches, *c.* 0.14 body circumference apart. Female pores paired. Spermathecal pores large, paired in 7/8, *c.* 0.12 body circumference apart.

Genital markings (Fig. 44b) single presetal extending beyond the line on the male pores, on *xix* and *xx*, postsetal crescentic markings of *xviii* absent.

Internal characters. Septa 5/6/7/8 thickened, 8/9 membranous, 9/10 absent 10/11/12/13/14 membranous. Intestine begins in *xvi*. Lateral hearts in *x–xii*.

Holandric, testes sacs paired, large with dorsal connections between the members of a pair, enclosing the lateral hearts and in *xi* the seminal vesicles. Seminal vesicles in *xi* small, in *xii* large, extending to the dorsal line. Male pores on elongate penes within coelomic copulatory pouches. Spermathecae (Fig. 33l) paired in *viii*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 2C Moist medium to heavy dark loam with considerable organic content, covered by mat of *Paspalum*, bank of small creek running through no. 12 paddock, Sepik plains Livestock station, Urimo, Wewak, Sepik district, Papua New Guinea, 3° 49' S, 143° 41' E, coll J W Copland 11 Nov 1971; BMNH 1976.3.11–12 (syntypes of *stingi*). 1C, 1A Data and collector as above; BMNH 1977.1. 151–152 (syntypes of *stingi*).

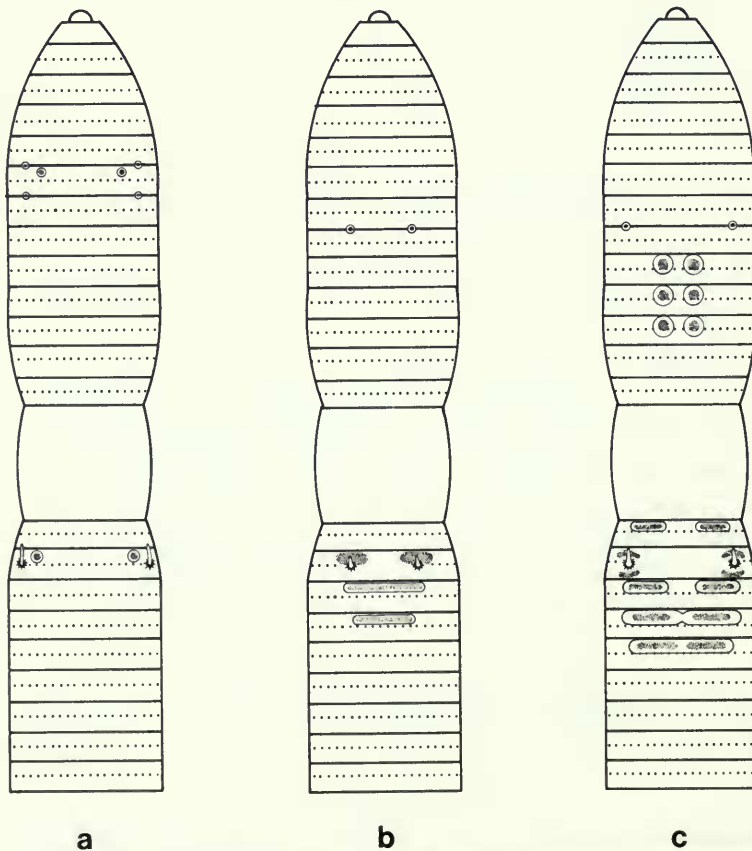


Fig. 44 Anterior ventral surface, diagnostic characters. (a) *Metapheretima andurili* sp. nov.; (b) *M. stingi* sp. nov.; (c) *M. oinakensis*.

Metapheretima oinakensis (Cognetti, 1914)

Pheretima oinakensis Cognetti, 1914 : 355.

Metapheretima oinakensis: Sims & Easton, 1972 : 181, 233.

DIAGNOSIS. *Metapheretima* with male pores on penes within copulatory pouches; paired spermathecal pores about one quarter of the body circumference apart in furrow 7/8. Holandric. Spermathecal diverticula simple and ental. Postclitellar genital field as Fig. 44c.

DESCRIPTION. *External characters.* Length 38–107 mm, diameter 3–4 mm. 90–156 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae 100–120 on *vii*, 30–60 on *xx*, setal ring regular on preclitellar segments ($aa = ab = yz = zz$), with ventral gaps on postclitellar segments ($aa = 2ab = 2yz = 2zz$).

Male pores on slim elongate penes within copulatory pouches, *c.* 0.25 body circumference apart. Female pores paired. Spermathecal pores, large, paired, in 7/8, *c.* 0.25 body circumference apart.

Genital markings (Fig. 44c) paired, presetal on *ix–xiii* median to the line of the spermathecal pores, on *xviii, xix–xxii*, median to the line of the male pores.

Internal characters. Septa 5/6/7/8 thickened, 8/9 absent, 9/10–12/13 membranous. Intestine begins in *xv*. Lateral hearts in *ix–xii*.

Holandric, testes sacs small paired, ventral in *x*, paired, extending to the dorsal line in *xi*. Seminal vesicles small, in *ix* enclosed by the testes sacs. Pseudoseminal vesicles small *xiv*. Spermathecae (Fig. 33m) paired in *viii*.

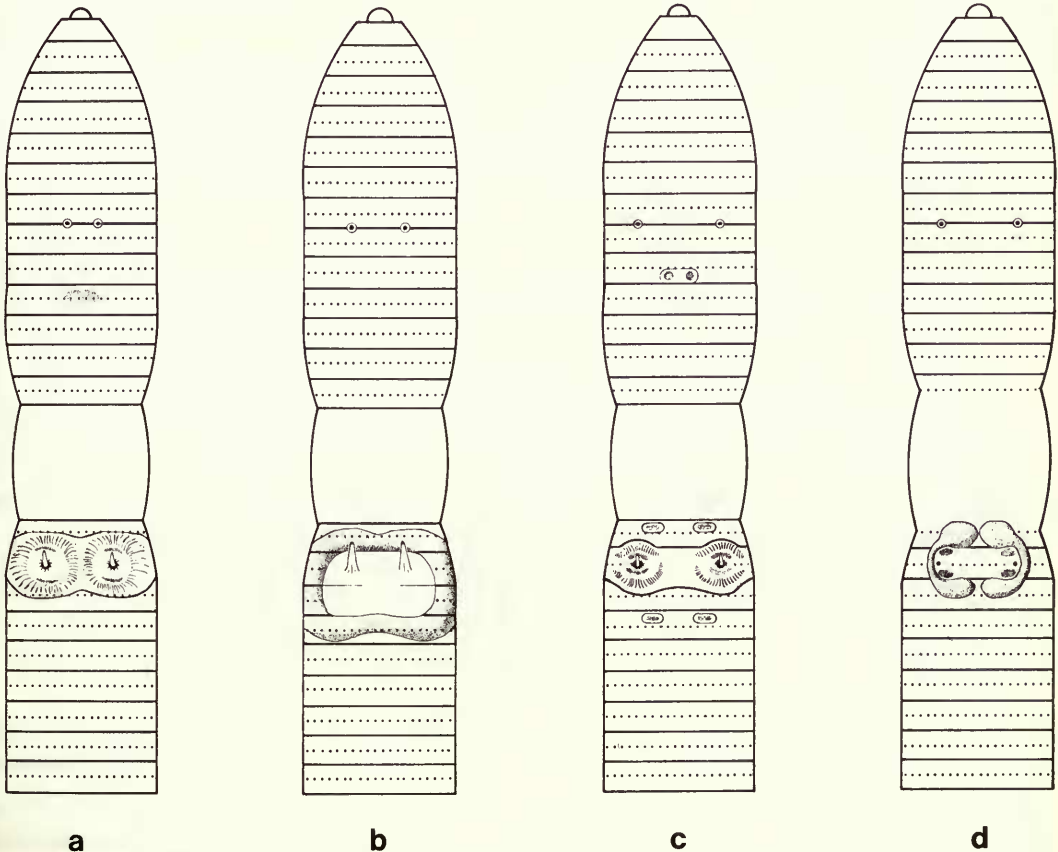


Fig. 45 Anterior ventral surface, diagnostic characters. (a) *Metapheretima orcrista* sp. nov.; (b) *M. parmata*; (c) *M. glamdringi* sp. nov.; (d) *M. jocchana*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. *Previously reported*. 1C Oinake, New Guinea; Leiden 1838 (holotype of *oinakensis*).

New record. 9C, 1A Moist dark loam of moderate to high organic content, sloping plot being prepared for Kaukau, or boundary of Wabag, Western Highlands, Papua New Guinea, altitude 2000–3000 m, coll J W Copland 16 Nov 1971; BMNH 1976.3.1–10.

Metapheretima orcrista sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on elongate penes within copulatory pouches; paired spermathecal pores about one twelfth of the body circumference apart in furrow 7/8. Holandric. Spermathecal diverticula simple and ental. Male pores surrounded by a well-developed glandular ridge (Fig. 45a).

DESCRIPTION. *External characters*. Length 72–95 mm, diameter 2–4 mm. 112–140 segments. Clitellum *xiv–xvi*. First dorsal pore 12/13. Setae, *c.* 140 on *vii*, *c.* 50 on *xx*, setal ring regular on preclitellar segments ($aa=ab=yz=zz$), with dorsal and ventral gaps on postclitellar segments ($aa=2ab=2yz=zz$).

Male pores on elongate penes within copulatory pouches, *c.* 0·12 body circumference apart. Female pore single. Spermathecal pores large, paired, in 7/8, *c.* 0·07 body circumference apart.

Genital markings (Fig. 45a), single, median, presetal to setal on *x*. Openings of the copulatory pouches are depressed and surrounded by a glandular ridge which occupies *xvii–xix*. This ridge also separates the two pores. On the inner surface of this glandular wall are two pairs of faint, slightly crescentic markings, one pair at 17/18 and the other pair at 19/20, both pairs in line with the male pores.

Internal characters. Septa 5/6/7/8 thickened, 8/9 absent, 9/10 membranous, 10/11 absent, 11/12/13/14 membranous or slightly thickened. Intestine begins in *xvi*. Lateral hearts in *x–xii*.

Holandric, testes sacs paired, small, ventral in *x* and *xi*. Seminal vesicles paired, in *xi* large, in *xii* smaller, both pairs extending to the dorsal line. Male pores on elongate penes within small coelomic copulatory pouches. Spermathecae (Fig. 33n), paired in *viii*.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 5C 15 cm layer of black soil over sandy soil, cultivated for gardens, halfway up hill from creek, Department of Agriculture, Stock and Fisheries Piggery, Goroka, Eastern Highlands, Papua New Guinea, 6° 02' S, 145° 22' E, altitude *c.* 3000 m, coll J W Copland 13 Oct 1971; BMNH 1976.3.17–21 (syntypes of *orcrista*). 1C Data and collector as above; BMNH 1977.1.42. 2C, 2A DASF Piggery, Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 1 Sep 1971; BMNH 1977.1.38–41. 1C Moist dark loam of moderate to high organic content, sloping plot being prepared for Kaukau, on boundary of Wabag, Western Highlands, Papua New Guinea, coll J W Copland; BMNH 1976.3.16. 1C Dark sandy loam covered by light vegetation, 120–150 m above Nupa village, Bena Bena subdistrict, *c.* 24 km east of Goroka, Eastern Highlands, Papua New Guinea, coll J W Copland 12 Oct 1971; BMNH 1976.3.22.

Metapheretima parmata (Ude, 1924)

Pheretima parmata Ude, 1924 : 80.

Pheretima (Pheretima) parmata: Ude, 1932 : 134.

Metapheretima parmata: Sims & Easton, 1972 : 233.

DIAGNOSIS. *Metapheretima* with male pores on slim penes; closely paired spermathecal pores in furrow 7/8. Holandric. Spermathecal diverticula simple ental in origin. Glandular ridges associated with the male pores extending from *xvii* to *xx* (Fig. 45b).

DESCRIPTION. *External characters*. Length *c.* 110 mm, diameter *c.* 3·5 mm. *C.* 180 segments. Clitellum *xiv–xvi*. First dorsal pore 10/11. Setae, 50–65 on *vii*, setal ring with ventral gaps ($aa=2ab$).

Male pores on slim elongate penes originating directly from the body wall, closely paired. Female pores not seen. Spermathecal pores closely paired, in 7/8, in line with the male pores.

Genital markings absent but the male pores are surrounded by a glandular wall extending from xvii-xx (Fig. 45b).

Internal characters. Septa 4/5-7/8 thickened, 8/9 absent, 9/10-13/14 membranous. Intestine begins in xv. Last heart in xii.

Holandric, testes sacs paired, x, xi, seminal vesicles in xi and xii. Pseudoseminal vesicles not recorded. Spermathecae paired in viii, duct longer than ampulla, diverticulum small, pyriform, ental.

Description after Ude (1924, 1932).

DISTRIBUTION. New Guinea.

REMARKS. This species is known only from the descriptions of Ude (1924, 1932) which are incomplete. Several details of the morphology are unknown, but it is suspected that the spermathecal pores are large as in other species with male pores on penes.

RECORDS. Sepik river (Kaiserin Augusta), Papua New Guinea; Berlin 6474 (type(s) of *parmata*). This series is listed in the catalogue of the Berlin Museum but was lost between 1938 and 1945: Dr Hartwich, personal communication.

Metapheretima glamdringi sp. nov.

DIAGNOSIS. *Metapheretima* with male pores on slim penes within copulatory pouches; paired spermathecal pores about one fifth of the body circumference apart in furrow 7/8. Proandric. Spermathecal diverticula simple ental in origin. Male pores surrounded by glandular ridge restricted to xviii (Fig. 45c).

DESCRIPTION. *External characters.* Length 130-138 mm, diameter 4-5 mm. 186-189 segments. Clitellum xiv-xvi. First dorsal pore 12/13. Setae, c. 190 on vii, c. 82 on xx, setal ring regular although often with displaced setae on preclitellar segments ($aa=ab=yz=zz$), with ventral gaps and no displaced setae on postclitellar segments ($aa=2ab=2yz=2zz$).

Male pores on elongate penes within copulatory pouches, c. 0.18 body circumference apart. Female pores paired. Spermathecal pores large, paired, transverse slits, in 7/8, c. 0.18 body circumference apart.

Genital markings (Fig. 45c) paired, postsetal on ix, paired, presetal on xvii, postsetal-intersegmental on xix-xx. In addition the male pores are surrounded by a glandular wall similar to that found in *orcrista*.

Internal characters. Septa 5/6/7/8 thick, 8/9 membranous, 9/10 absent, 10/11-13/14 membranous or slightly thickened. Beginning of intestine not seen. Lateral hearts in x-xii.

Proandric, testes sacs paired, ventral in x, seminal vesicles large, reaching the dorsal line in xi. Male pores on penes within small coelomic copulatory pouches. Spermathecae (Fig. 33o) paired in viii.

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED. 2C, 1A Dense clay with dense organic matter, covered by thin grass cover, side of road adjacent to coffee plantation, Amahab village, c. 16 km west of Maprik, Sepik district, Papua New Guinea, 3° 38' S, 142° 55' E, altitude 200-500 m, coll J W Copland 12 Nov 1971; BMNH 1976.3.13-15 (syntypes of *glamdringi*).

Metapheretima jocchana (Cognetti, 1911)

Pheretima jocchana Cognetti, 1911 : 5; Cognetti, 1912 : 544; Cognetti, 1914 : 352.

Pheretima (Pheretima) jocchana: Ude, 1932 : 144; (= ? *kampeni*) Michaelsen, 1938 : 161.

Metapheretima jocchana: Sims & Easton, 1972 : 233, 180.

Pheretima kampeni Cognetti, 1914 : 356.

Metapheretima kampeni: Sims & Easton, 1972 : 233.

Pheretima tumulifaciens Lee, 1967 : 59.

Archipheretima tumulifaciens: Sims & Easton, 1972 : 232.

DIAGNOSIS. *Metapheretima* with large simple male pores; large paired spermathecal pores about one fifth of the body circumference apart in furrow 7/8. Holandric. Spermathecal diverticula small, numerous, ental in origin.

DESCRIPTION. *External characters.* Length 200–600 mm, diameter 6–10 mm. 200–600 segments. Clitellum $\frac{1}{2}$ xiii– $\frac{1}{2}$ xviii. First dorsal pore 10/11, 11/12, or 12/13. Setae 150–200 on *vii*, 160–180 on *xx*, setal ring regular ($aa=ab=yz=zz$).

Male pores simple, partially invaginated in mature individuals, *c.* 0.30 body circumference apart. Female pores paired, occasionally single. Spermathecal pores large, paired, in 7/8, *c.* 0.20 body circumference apart.

Genital markings (Fig. 45d). In juveniles the markings are paired median to the male pores, postsetal on *xvii*, presetal on *xix*. With maturity the markings enlarge laterally to form a glandular ridge enclosing the male pores.

Internal characters. Septa 5/6–12/13 thickened. Intestine begins in *xvi*. Lateral hearts in *x–xiii*.

Holandric, testes sacs small paired, ventral in *x*, annular in *xi*, seminal vesicles paired, in *xi* enclosed in the testes sacs, and in *xii*. Pseudoseminal vesicles in *xiv*. Spermathecae (Fig. 33p) paired in *viii*.

DISTRIBUTION. New Guinea.

REMARKS. On the basis of the original description, Sims & Easton (1972) placed *tumulifaciens* in the genus *Archipheretima*. Following an examination of the type series *tumulifaciens* is now transferred to *Metapheretima*, and placed in the synonymy of *jocchana*.

MATERIAL EXAMINED. *Previously reported.* 2C Jaga, near lake Sentani, West Irian; Amsterdam Vol 273 (syntypes of *jocchana*). 3C Njao, West Irian; Leiden 1812 (syntypes of *kampeni*). 3A Haripmar village, Sepik valley; Papua New Guinea; Adelaide 940–941 (holotype and paratypes of *tumulifaciens*).

New records. 5A Moist heavy dark soil with a lot of vegetation, holding paddock of AID station, previously a Copra plantation, outskirts of Madang, Madang district, Papua New Guinea, coll J W Copland; BMNH 1976.3.68–72. 7A River flats and banks, Sepik livestock station, Urimo, Wewak, Papua New Guinea, coll J W Copland 11 Nov; 1971 BMNH 1977.1.9–14.

OTHER RECORDS. New Guinea; Leiden 1851 (*jocchana*: Cognetti, 1914). New Guinea and Berlinhafer, Eilape, New Guinea; Berlin 6476, 6464 (*jocchana*: Ude, 1932). Siwia, New Guinea; Leiden 1852 (*jocchana*: Michaelsen, 1938).

PLEIONOGASTER Michaelsen, 1892

Perichaeta (part): Beddard, 1886 : 298.

Pleionogaster Michaelsen, 1892 : 247; Beddard, 1895 : 433; Michaelsen, 1896 : 198.

Plionogaster: Michaelsen, 1900 : 210; Stephenson, 1930 : 840; Gates, 1943 : 105; Jamieson, 1971a : 82.

TYPE SPECIES. *Pleionogaster jagori* Michaelsen, 1892, new designation (non *horsti* Beddard, 1886, invalid designation).

DIAGNOSIS. Megascolecidae with an oesophageal gizzard in *viii* and intestinal gizzards.

DESCRIPTION. As for the only species, *horsti*.

DISTRIBUTION. Philippines, ? Moluccas.

REMARKS. *Pleionogaster* was erected to accommodate two species, *jagori* and *samariensis*, but a type was not designated. Later *Perichaeta horsti* Beddard, 1886 was transferred to the genus and designated as the type species. This designation is invalid (Article 69, Int. Code Zool. Nomencl.) and one of the originally included species, *Pleionogaster jagori* Michaelsen, 1892 (a junior synonym of *horsti*) is here designated as the type of *Pleionogaster*.

The spelling of the name *Pleionogaster* has been the subject of confusion. Michaelsen (1892, 1896) and Beddard (1895) used the correct orthography, *Pleionogaster*, but in 1900 Michaelsen changed the spelling to *Plionogaster*, an unjustified emendation (Article 33, Int. Code Zool.

Nomencl.) which has been used by subsequent authors (Stephenson, 1930, 1933; Gates, 1943; Jamieson, 1971).

Pleionogaster horsti (Beddard, 1886)

Perichaeta horsti Beddard, 1886 : 300.

Pleionogaster horsti: Beddard, 1895 : 434; Michaelsen, 1900 : 211.

Pleionogaster jagori Michaelsen, 1892 : 247; Beddard, 1895 : 434; Michaelsen, 1900 : 211.

Pleionogaster samariensis Michaelsen, 1892 : 248; Beddard, 1895 : 434; Michaelsen, 1900 : 211.

Pleionogaster ternatae Michaelsen, 1896 : 198; Michaelsen, 1900 : 211.

Pleionogaster sivickisi Stephenson, 1933 : 923.

Pleionogaster sp. Gates, 1943 : 105.

DIAGNOSIS. As for the genus.

DESCRIPTION. *External characters.* Length 50–170 mm, diameter 3–5 mm. 190–270 segments. Body cylindrical, creeping sole absent. Clitellum annular, *xiv–xvii*. First dorsal pore 11/12 or 12/13. Setae perichaetine, 150–200 on *vii*, 70–84 on *xx*, setal ring regular without dorsal or ventral gaps ($aa = ab = yz = zz$).

Male pores simple, large, coincident with the prostatic pores, *c.* 0.24 body circumference apart. Female pore single or closely paired, median on *xiv*. Spermathecal pores large, paired, intersegmental in furrows 7/8/9, *c.* 0.23 body circumference apart.

Genital markings (Fig. 46a) paired, in line with the male pores and single median, presetal on *xvi*, *xvii*, *xix*, *xx*, paired, intersegmental, in line with the male pores at 17/18, 18/19.

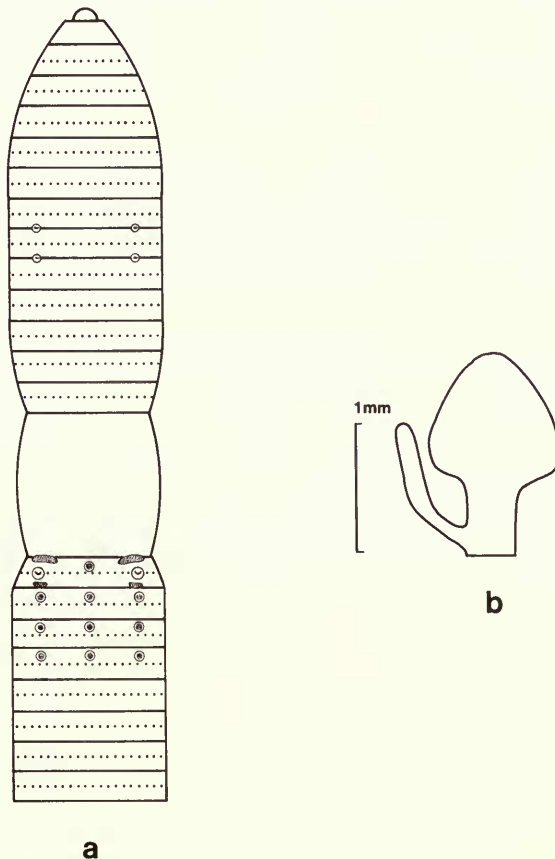


Fig. 46 *Pleionogaster horsti*. (a) Anterior ventral surface, diagnostic characters; (b) spermatheca.

Internal characters. Septa 4/5–8/9 thickened. Poorly developed oesophageal gizzard in *viii*. Oesophagus lacking calciferous glands and dorsal pouches. Intestine begins in *xix* with 3 or 4 gizzards, each *c.* $\frac{1}{2}$ segment in length, in *xxvi*, *xxvii*, *xviii* and occasionally *xxix*. Lateral hearts in *x–xiii*.

Holandric, testes sacs single, annular in *x* and *xi*, seminal vesicles small in *xi* and *xii*, enclosed in the testes sacs. One pair of racemose prostates discharging with the male ducts. Ovaries free, paired in *xiii*. Oviducts lead to single or closely paired median equatorial pore(s) on *xiv*. Spermathecae (Fig. 46b) paired in *viii* and *ix*.

DISTRIBUTION. Philippine Islands and possibly the Moluccas.

REMARKS. The taxa assigned to this species vary in the degree of development of the oesophageal gizzard, the number of intestinal gizzards and the number of genital markings. The variation in each of these characters is small and insufficient to justify the recognition of more than a single species.

The reported occurrence of this species in the Moluccas is based on the type of *ternatae* (Michaelsen, 1896). In the original description the type locality was cited as 'Ternate' but later this locality was qualified without explanation as 'Moluken (Ternate)' by Michaelsen (1900 : 211). Since this species has otherwise been reported only from the Philippines, it is uncertain whether this record should be attributed instead to Ternate, Luzon, Philippines and not to Ternate Island, Halmahera.

MATERIAL EXAMINED. 4 micro slides (longitudinal sections), Manila, Luzon, Philippines; BMNH 1974.1.86–89 (syntype of *horsti*). 2C Daraga, Luzon, Philippines; Hamburg v359 (syntypes of *jagori*). 1C 'Ternate' (Halmahera or Philippines ?); Hamburg v3838 (syntype of *ternatae*). 1C, 3A Manila, Luzon, Philippines; BMNH 1930.12.26.5–7 (syntypes if *sivickisi*).

OTHER RECORDS. 1 specimen, Samir Island, Philippines (holotype of *samariensis*). More than 3A Manila, Luzon, Philippines (*Pleionogaster* sp. Gates, 1943).

Species Incertae Sedis

Three species of the *Pheretima* group of genera are known only from individuals with damaged intestines and it is uncertain whether they possess intestinal caeca. They were listed as species *incertae sedis* by Sims & Easton (1972). Descriptions are provided below and the keys of the acaecate genera to which they are potential candidates for inclusion have provision for their recognition.

'*Pheretima*' *cupreae* Chen, 1946

Pheretima cupreae Chen, 1946 : 117.

Pheretima cupreae incertae sedis: Sims & Easton, 1972 : 224.

DESCRIPTION. *External characters.* Length *c.* 120 mm, diameter *c.* 6.5 mm. *C.* 95 segments. Clitellum *xiv–xvi*. First dorsal pore 11/12. Setae, *c.* 46 on *iii*, *c.* 52 on *vii*, *c.* 53 on *ix*, *c.* 50 on *xxv*, setal ring with ventral and dorsal gaps (*aa* = 1.2*ab*, 1.5–2*yz* = *zz*).

Male pores on small porophores, *c.* 0.33 body circumference apart. Female pore(s) not recorded. Spermathecal pores small, paired, presetal on *vii* and *viii*, *c.* 0.43 body circumference apart.

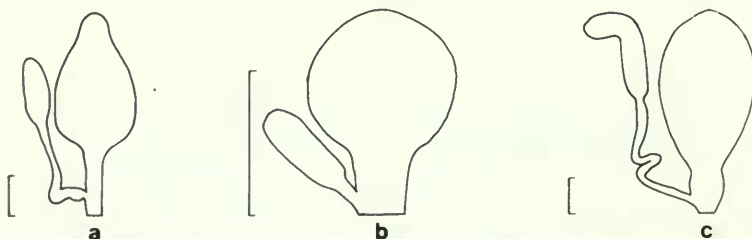


Fig. 47 Spermathecae. (a) '*Pheretima*' *cupreae*; (b) '*Pheretima*' *flabellifera*; (c) '*Pheretima*' *touranensis*. All scales 0.5 mm.

Genital markings (Fig. 48a) paired, pre- and postsetal, slightly median to the spermathecal pores on *vii* and *viii*, single, postsetal, median on *vii* and *viii*, paired, clusters of 3 or 4 papillae slightly median to the male pores on *xviii* and a pair of incomplete glandular walls enclose the male pores anteriorly, laterally and posteriorly.

Internal characters. Septa 5/6–7/8 thickened, 8/9/10 absent, 10/11–12/13 thickened. Intestine begins in *xv*. Lateral hearts not recorded.

Holandric, testes sacs paired in *x* and *xi*, seminal vesicles paired in *xi* and *xii*. Spermathecae (Fig. 47a) in *vii* and *viii*.

Description after Chen (1946).

DISTRIBUTION. Szechwan, China.

REMARKS. The majority of Chinese members of the *Pheretima* group belong to the caecate genera *Amyntas* and *Metaphire* so it is probable that *P. cupreae* possesses intestinal caeca and belongs to the former, *Amyntas*, where it would be accommodated in the *pomellus* species-group. However, *Pheretima cupreae* may be a candidate to two of the acaecate genera, *Polypheretima* and *Metapheretima*. The former, *Polypheretima*, has an indigenous range that comes close to China, but the presence of glandular walls associated with the male pores are reminiscent of the crescentic markings diagnostic of *Metapheretima*.

RECORDS. 1C (damaged) Mt King-Fu, Szechwan, China (holotype of *cupreae*).

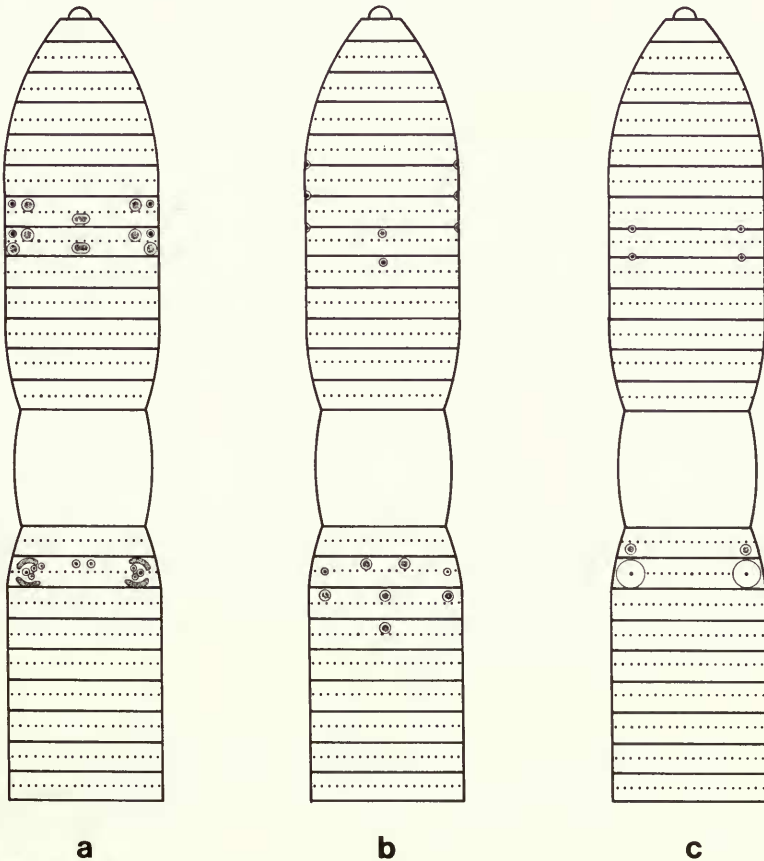


Fig. 48 Anterior ventral surface, diagnostic characters. (a) '*Pheretima*' *cupreae*; (b) '*Pheretima*' *flabellifera*; (c) '*Pheretima*' *touranensis*.

'*Pheretima*' *flabellifera* Cognetti, 1911

Pheretima flabellifera Cognetti, 1911 : 2; Cognetti, 1912 : 548.

Pheretima flabellifera incertae sedis: Sims & Easton, 1972 : 224.

DESCRIPTION. *External characters.* Length *c.* 26 mm, diameter *c.* 2.5 mm, *C.* 73 segments. Clitellum *xiv-xvi*. First dorsal pore not recognized. Setae, *c.* 50 on *vii* and *xx*, setal ring with ventral (? and possibly dorsal) gaps ($aa = 1.5ab = 1.5yz$).

Male pores on circular porophores *c.* 0.35 body circumference apart. Female pore single. Spermathecal pores small, paired, intersegmental in *5/6/7/8*, *c.* 0.50 body circumference apart.

Genital markings (Fig. 48b) single, median on *viii* and *ix*, paired, presetal, median to the male pores on *xviii*, paired, presetal, in line with the male pores on *xix*, single median, presetal on *xix* and *xx*.

Internal characters. Anterior septa present and delicate. Intestine begins in *xv*, intestinal caeca ? Lateral hearts in *x-xii*.

Holandric, testes sacs paired, small, ventral in *x* and *xi*, seminal vesicles extending to the dorsal line in *xi* and *xii*. Spermathecae (Fig. 47b) paired in *vi-viii*.

DISTRIBUTION. New Guinea.

REMARKS. Until data about the intestinal caeca become available for this species, it may be considered to be candidate for three genera of the *Pheretima* group of genera, *Amyntas*, *Pithemera* and *Polypheretima*. With intestinal caeca it would be eligible to be included in *Amyntas*, and belong to the *hawayanus* species-group (unknown in the Papuan area) or *Pithemera*. If it should lack caeca, then it would become a member of *Polypheretima* where its affinities would then be with the *bifaria* species-group which is also indigenous in New Guinea.

MATERIAL EXAMINED. 1C Meniheon Geb. West Irian; Amsterdam Vol 254 (holotype of *flabellifera*).

'*Pheretima*' *touranensis* Michaelsen, 1934

Pheretima (Pheretima) touranensis Michaelsen, 1934c : 499.

Pheretima touranensis incertae sedis: Sims & Easton, 1972 : 225.

DESCRIPTION. *External characters.* Length 110 mm, diameter 3.5-4 mm. *C.* 90 segments. Clitellum *xiv-xvi*. First dorsal pore not recorded. Setae, *c.* 44 on *v*, *c.* 52 on *ix*, *c.* 56 on *xiii*, setal ring regular without dorsal and ventral gaps ($aa = ab = yz = zz$).

Male pores on large, wart-like papillae which occupy the whole length of the segment, *c.* 0.40 body circumference apart. Female pore(s) not recorded. Spermathecal pores paired, intersegmental in *7/8/9*, *c.* 0.28 body circumference apart.

Genital markings (Fig. 48c) paired, postsetal, in line with male pores, on *xvii*.

Internal characters. Septa *6/7/8* slightly thickened, *8/9/10* absent, *10/11-13/14* moderately thickened. Beginning of intestine not recorded, intestinal caeca ? Lateral hearts not recorded.

Holandric, testes sacs small, paired in *x* and *xi*, seminal vesicles large, broad, sack shaped in *xi* and *xii*. Spermathecae (Fig. 47c) paired in *viii* and *ix*.

Description and Fig. 47c after Michaelsen (1934); Fig. 48c is an interpretation of the genital field based on Michaelsen's written description.

DISTRIBUTION. Vietnam.

REMARKS. Until details of the intestinal caeca become available for this species it is considered as a candidate for inclusion in three genera of the *Pheretima* group, *Amyntas*, *Pithemera* and *Polypheretima*. If it should prove to belong to *Polypheretima* then it would be included within the *bifaria* species-group.

RECORDS. 1C (badly macerated) Tourane, Vietnam (holotype of *touranensis*).

Species transferred to caecate genera of the Pheretima group

Two of the species provisionally assigned to *Metapheretima*, one included in *Planapheretima* and four listed as *incertae sedis* by Sims & Easton (1972), are now transferred to *Amyntas* on the basis of the data discussed below.

Perichaeta subquadrangula Grube, 1877. The original description of this species is incomplete and causes doubt whether the taxon should be included within the *Pheretima* group of genera. Examination of the type specimens (Berlin 706) reveal that it belongs to the *Amyntas diffringens* species-group and that it is probably synonymous with *A. diffringens* (Baird, 1869).

Perichaeta pusilla Ude, 1893 (non *Pheretima pusilla* Ohfuchi, 1956) and *Pheretima enchytraeoides* Michaelsen, 1916. The original descriptions lack information regarding the presence or absence of intestinal caeca. Gates (1961 : 298) is of the opinion that they are both synonymous with *Amyntas minimus* (Horst, 1893). The name *A. minimus* has priority; although an exact date of publication cannot be established for Horst's paper a copy was received by the library of the British Museum (Natural History) on 2 August 1893 while Ude's paper was not published until 12 December 1893.

Pheretima monopera Cognetti, 1911. Damage to the intestine in the region of the intestinal caeca of the unique holotype prevented Cognetti from recognizing these structures. Among recent additions to the collections of the British Museum (Natural History) are several individuals of *monopera*. They all possess caeca so the species *monopera* is now transferred to *Amyntas*.

Pheretima liangi Michaelsen, 1922 was assigned to *Metapheretima* by Sims & Easton (1972) since the original description recorded the absence of intestinal caeca. Re-examination of the unique holotype – Leiden 1813 (2 fragments of body wall); Hamburg v9299 (3 spermathecae, pharynx, gizzard and anterior portion of intestine) – revealed that caeca are present but it was not possible to establish in which segment the caeca originate. It is proposed to transfer the taxon to the genus *Amyntas* and include it in the *A. diffringens* species-group – it could possibly be assigned to the *Pithemera pacifica* group; however, it differs from the members of this group by being holandric.

Pheretima petahana Michaelsen, 1934 was tentatively included in *Metapheretima* since Michaelson noted that it probably lacked intestinal caeca. No further data can be obtained from a re-examination of the unique holotype (Amsterdam Vol. 293) since all internal structures have been removed. However, a short series of specimens (Stockholm 462) contain three clitellate individuals assignable to this species on external characters. Since these specimens have intestinal caeca originating in xxvii, the species is now transferred to *Amyntas* where it is included in the *A. aeruginosus* species-group.

Pheretima hirudinaria Gates, 1958 was assigned to *Planapheretima* by Sims & Easton (1972) since the original description recorded crowded ventral setae and a depressed body. Examination of the unique holotype – New York 7283 – revealed that the body was only slightly depressed, possibly a result of the fixation technique employed, and the setae were not crowded ventrally. In the absence of the generic characters of *Planapheretima* the species has been transferred to *Amyntas* where it is accommodated in the *A. diffringens* species-group. Gates (1958) was only able to detect a single lateral caecum on the left side of the holotype. Re-examination of the holotype revealed that a caecum was present on the right-hand side of the intestine although it was not as well developed as that on the left-hand side.

Several species were omitted from the numerical studies of Sims & Easton (1972) or have been described since in the genus *Pheretima*. They are assigned to the following genera:

Amyntas

A. areniphilus (Chen & Hsü, 1975: 91) (cf. *A. rubellus*).

A. geojeisulae (Song & Paik, 1970a : 11) (*A. morrissi* species-group).

A. gucheonensis (Song & Paik, 1970b : 105) (*A. tokioensis* species-group).

A. heterogens (Chen & Hsü, 1975: 96) (*A. sieboldi* species-group).

A. jiriensis (Song & Paik, 1971 : 193) (*A. tokioensis* species-group).

A. loti (Chen & Hsü, 1975: 93) (*A. sieboldi* species-group).

A. mediocus (Chen & Hsü, 1975: 92) (*A. diffringens* species-group).

A. nanulus (Chen & Yang, 1975: 89) (*A. morrissi* species-group).

- A. seungpanensis* (Song & Paik, 1970a : 11) (*A. canaliculatus* species-group).
A. tschiliensis kokoanus (Chen & Fang, 1975 : 94) (*A. sieboldi* species-group).
Metaphire
M. cruroides (Chen & Hsü, 1975 : 93) (*M. houletti* species-group).
M. yapensis (Ohfuchi, 1941 : 283) (*M. houletti* species-group).
Pithemera
P. aimerikiensis (Ohfuchi, 1941 : 302) (*P. bicinta* species-group).
P. eldoni (Gates, 1975 : 6).
P. mira (Gates, 1972b : 121) (*P. sedgwicki* species-group).
P. palaoensis (Ohfuchi, 1941 : 287).

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References

- Aiyer, K. S. P. 1929. An account of the Oligochaeta from Travencore. *Rec. Indian Mus.* 31 : 13-76.
 Bahl, K. N. 1919. On a new type of nephridial system found in Indian earthworms of the genus *Pheretima*. *Q. Jl microsc. Sci.* 64 : 67-119.
 — 1924. On the occurrence of the 'entronephric' type of nephridial system in the genus *Lampito*. *Q. Jl microsc. Sci.* 68 : 67-99.
 — 1946. Studies on the structure, development and physiology of the nephridia of Oligochaeta. Part VII. The enteronephric type of nephridial system in earthworms belonging to three species of *Megascolex* Templeton and three species of *Travoscolides* Gates (*Megascolides* McCoy). *Q. Jl microsc. Sci.* 87 : 45-60.
 Baird, W. 1869. Description of a new species of earthworm (*Megascolex diffringens*) found in north Wales. *Proc. zool. Soc. Lond.* 1869 : 40-43.

- Beddard, F. E.** 1886. Descriptions of some new or little known earthworms, together with an account of the variations in structure exhibited by *Perionyx excavatus*, E.P. *Proc. zool. Soc. Lond.* **1886** : 298–314.
- 1888. Preliminary note on the nephridia of *Perichaeta*. *Proc. R. Soc.* **43** : 309–310.
- 1890. The classification and distribution of earthworms. *Proc. R. phys. Soc. Edinb.* **10** : 235–290.
- 1892. On some species of the genus *Perichaeta* (sensu stricto). *Proc. zool. Soc. Lond.* **1892** : 153–172.
- 1895. *A monograph of the order Oligochaeta*. pp. i–xii, 1–769. Oxford: Clarendon Press.
- 1899. On a collection of earthworms from New Britain, the Solomon Islands, the New Hebrides and the Loyalty Islands. In A. Willey, *Zoological results based on material collected in New Britain, New Guinea, Loyalty Islands and elsewhere*. **1** (2): 181–194.
- 1900a. A revision of the earthworms of the genus *Amyntas* (*Perichaeta*). *Proc. zool. Soc. Lond.* **1900** : 609–652.
- 1900b. On the earthworms collected during the 'Skeat Expedition' to the Malay Peninsula 1899–1900. *Proc. zool. Soc. Lond.* **1900** : 891–911.
- 1912. The oligochaeta terricolae of the Philippines part I. The genus *Pheretima*. *Philipp. J. Sci.* (ser. D) **7** : 179–203.
- Beddard, F. E. & Fedarb, S. M.** 1895. On some Perichaetidae from the Eastern Archipelago collected by Mr Everett. *Ann. Mag. nat. Hist.* (ser. 6) **16** : 69–73.
- — 1902. On a new coelomic organ in an earthworm. *Proc. zool. Soc. Lond.* **1902** : 164–168.
- Chapman, G.** 1958. The hydrostatic skeleton in the invertebrates. *Biol. Rev.* **33** : 338–371.
- Chen, Y.** 1931. On the terrestrial oligochaeta from Szechuan. *Contr. biol. Lab. Sci. Soc. China (zool.)* **7** : 117–171.
- 1936. On the terrestrial oligochaeta from Szechuan II with notes on Gates' types. *Contr. biol. Lab. Sci. Soc. China (zool.)* **11** : 269–306.
- 1946. On the terrestrial oligochaeta from Szechuan III. *Jl W. China Border Res. Soc.* **16** : 83–141.
- Chen, Y., Hsü, C. F., Yang, T. & Fong, H. Y.** 1975. On some new earthworms from China. *Acta zool. sin.* **21** : 89–99.
- Cognetti de Martiis, L.** 1908. Contributo alla conoscenza della drilofauna papuasica. *Boll. Musei. Zool. Anat. comp. R. Univ. Torino* **23** (584) : 1–4.
- 1909. Nuove specie dei generi *Megascoledes* e *Pheretima*. *Annali. Mus. civ. Stor. nat. Giacoma Doria* **4** : 327–334.
- 1911. Nuove specie dei generi *Pheretima* e *Dichogaster* (Diagn. prel.). *Boll. Musei. Zool. Anat. comp. R. Univ. Torino* **26** (641) : 1–7.
- 1912. Oligochaeta recueillis pendant la 'Nederl. Nieuw-Guinea-Expeditie' (1903). *Nova Guinea* **5** : 543–564.
- 1913. Oligochètes recueillis pendant les expéditions à la Nouvelle-Guinée méridionale conduites par Mr. H. A. Lorentz en 1907 et 1909–1910 et par Mr. J. W. R. Koch, médecin de l'expédition en 1904. *Nova Guinea* **9** : 289–304.
- 1914. Zur Fauna von Nord-Neuguinea (nach den Sammlungen von Dr. P. N. von Kampen und K. Gjellerupi). Descrizione di alcuni Oligocheti della Nuova Guinea settentrionale. *Zool. Jb. syst.* **37** : 351–364.
- Easton, E. G.** 1976. Taxonomy and distribution of the *Metapheretima elongata* species-complex of Indo-Australasian earthworms (Megascolecidae: Oligochaeta). *Bull. Br. Mus. nat. Hist. (Zool.)* **30** : 31–53.
- Fletcher, J. J.** 1887. Notes on Australian earthworms part II. *Proc. Linn. Soc. N.S.W.* **1** : 943–973.
- Gates, G. E.** 1929. A summary of the earthworm fauna of Burma with descriptions of fourteen new species. *Proc. U.S. natn. Mus.* **75** : 1–41.
- 1935. On some earthworms from east Perak and Christmas Island. *Bull. Raffles Mus.* **10** : 80–95.
- 1936a. The earthworms of Burma V. *Rec. Indian Mus.* **38** : 377–468.
- 1936b. On some earthworms from the Buitenzorg Museum. *Treubia* **15** : 379–393.
- 1937a. The genus *Pheretima* in North America. *Bull. Mus. comp. Zool. Harv.* **80** : 339–373.
- 1937b. Indian earthworms I. The genus *Pheretima*. *Rec. Indian Mus.* **39** : 175–212.
- 1941. Preoccupied names in the Oligochaeta. *Rec. Indian Mus.* **43** : 497.
- 1943. On some American and Oriental earthworms part II. Family Megascolecidae. *Ohio J. Sci.* **43** : 99–116.
- 1945. On some earthworms from Ceylon II. *Spolia zeylan.* **24** : 69–90.
- 1948. On some earthworms from the Buitenzorg Museum III. Results of the Third Archbold Expedition 1938–39, Oligochaeta. *Treubia* **19** : 139–166.
- 1956. Reproductive organ polymorphism in earthworms of the oriental Megascolecine genus *Pheretima*. Kinberg, 1867. *Evolution, Lancaster Pa.* **10** : 213–227.
- 1957. Earthworms. *Nat. Hist. Rennell Isl.* **2** : 7–23.

- 1958. On some species of the Oriental Earthworm genus *Pheretima* Kinberg, 1867, with a key to species reported from the Americas. *Am. Mus. Novit.* **1888** : 1–33.
- 1959. On a taxonomic puzzle and the classification of earthworms. *Bull. Mus. comp. Zool. Harv.* **121** : 229–261.
- 1961. On some species of the oriental earthworm genus *Pheretima* Kinberg, 1867. *Zool. Meded. Leiden* **37** : 293–312.
- 1970a. On an interesting Philippine species of the earthworm genus *Pheretima*, Kinberg, 1866 (Oligochaeta, Annelida). *Proc. biol. Soc. Wash.* **83** : 155–159.
- 1970b. On some New Guinea earthworms. *Aust. Zool.* **15** : 386–390.
- 1970c. Miscellanea Megadrilologica, VIII. *Megadrilologica* **1** (2) : 1–14.
- 1972a. Burmese Earthworms, an introduction to the systematics and biology of Megadrile Oligochaetes with special reference to Southeast Asia. *Trans. Am. phil. Soc.* **62** (7) : 1–326.
- 1972b. On the *sedgwicki* complex of the earthworm genus *Pheretima* Kinberg, 1866. *Micronesica* **8** : 117–124.
- 1975. On a few earthworms from New Guinea (Oligochaeta). *Megadrilologica* **2** : 6–8.
- Goto, S. & Hatai, S. 1898. New or imperfectly known species of earthworms. No 1. *Annot. zool. jap.* **2** : 65–78.
- — 1899. New or imperfectly known species of earthworms, No. 2. *Annot. zool. jap.* **3** : 13–24.
- Grant, W. C. 1955. An anatomical study of the perigrine Megascolecoïd earthworm *Pheretima hupiensis* in the eastern United States. *Proc. U.S. natn. Mus.* **105** : 49–63.
- Griffiths, J. R. 1971. Reconstruction of the south-west Pacific margin of Gondwanaland. *Nature, Lond.* **234** : 203–207.
- Grube, E. 1877. Anneliden ausbeute S.M.S. Gazelle. *Mber. K. preuss. Akad. Wiss.* **1877** : 509–554.
- Hatai, S. 1924. Reply to the remarks of Prof. Wilhelm Michaelsen concerning the *Perichaeta megascolidioides* Goto and Hatai, and further observations made on this species on the relation of body length to the number of segments and of setae. *Sci. Rep. Tohoku Univ.* **1** : 23–42.
- Horst, R. 1883. New species of the genus *Megascolex* Templeton (*Perichaeta* Schmarda) in the collections of the Leyden Museum. *Notes Leyden Mus.* **5** : 182–196.
- 1885. Vermes. *Midden Sumatra* **4** (12) : 1–11.
- 1890. Descriptions of Earthworms. No. 5. On two new *Perichaeta* species. *Notes Leyden Mus.* **12** : 231–237.
- 1893. Earthworms from the Malayan Archipelago. In M. Weber (Ed.), *Zoologische Ergebnisse einer Reise in Niederländisch Ost Indien.* **3** : 28–83.
- Jamieson, B. G. M. 1971a. A review of the Megascolecoïd earthworm genera (Oligochaeta) of Australia. Part 1 – Reclassification and checklist of the Megascolecoïd genera of the world. *Proc. R. Soc. Qd* **82** : 75–86.
- 1971b. A review of the Megascolecoïd earthworm genera (Oligochaeta) of Australia. Part III – The subfamily Megascolecinae. *Mem. Qd Mus.* **16** : 69–102.
- Kinberg, J. G. H. 1867. Annulata nova. *Ofvers. K. Vetensk Acad. Förh. Stockh.* **23** : 97–103, 356–357.
- Kobayashi, S. 1934. Three new Korean earthworms belonging to the genus *Pheretima* together with the wider range of distribution of *Pheretima hilgendorfi* (Michaelsen). *J. Chosen nat. Hist. Soc.* **19** : 1–11.
- 1940. Terrestrial Oligochaeta from Manchoukuo. *Sci. Rep. Tohoku Univ.* **15** : 261–315.
- 1941a. 'Terrestrial Oligochaeta from the Shikoku, Chugoku, Kinki and Chubu areas.' (In Japanese.) *Zool. Mag. Tokyo* **53** : 258–266.
- 1941b. 'The distribution of Oligochaeta in western Japan.' (In Japanese.) *Zool. Mag. Tokyo* **53** : 371–384.
- Krishnan, M. S. 1952. Geological history of the Rajastan and its relation to present day conditions. *Bull. natn. Inst. Sci. India* **1** : 19–31.
- Lee, K. E. 1959. The earthworm fauna of New Zealand. *Bull. N.Z. Dep. scient. ind. Res.* **130** : 1–486.
- 1967. *Pheretima tumulifaciens* (Oligochaeta, Megascolecoïdæ). A new species of earthworm from the Sepik district, New Guinea. *Trans. R. Soc. S. Aust.* **91** : 59–63.
- 1969. Earthworms of the British Solomon Island Protectorate. *Phil. Trans. R. Soc. Lond.* **255** : 345–354.
- Michaelsen, W. 1891. Oligochaeten des Naturhistorischen Museum in Hamburg, IV. *Jb. hamb. wiss. Anst.* **8** (2) : 1–42.
- 1892. Terricolen der Berliner Zoologischen Sammlung, II. *Arch. Naturgesch.* **58** : 209–261.
- 1896. Oligochäten Kükenthal – Ergebnisse einer zool. Forschungsreise in den Molukken und in Borneo. *Abh. senckenb. naturforsch. Ges.* **23** : 192–243.
- 1897. Die Terricolen de Madagassischen Inselgebiets. *Abh. senckenb. naturforsch. Ges.* **21** : 219–252.

- 1899. Terricolen von verschiedenen Gebieten der Erde. *Jb. Hamb. wiss. Anst.* **16** (2) : 1–122.
- 1900. Oligochaeta. *Tierrich* **10** : 1–575.
- 1903a. Oligochaeten von Peradeniya auf Ceylon. *Sber. K. böhm. Ges. Wiss. Math.-nat. Kl.* **50** : 1–16.
- 1903b. *Die geographische Verbreitung der Oligochaeten*, pp. 1–186. Berlin: Friedländer & Sohn.
- 1907. Oligochäten von Madagaska, den Comoren und anderen Inseln des westlichen Indischen Ozeans. *Wiss. Ergebn. Reise Ostafst.* **2** : 41–50.
- 1908. The Oligochaeta of India, Nepal, Ceylon, Burma and Andaman Islands. *Mem. Indian Mus.* **1** : 103–253.
- 1910a. Oligochäten von den Aru und Kei-Inseln. *Abh. senckenb. naturforsch. Ges.* **33** : 251–261.
- 1910b. Oligochäten von verschiedenen Gebieten. *Jb. hamb. wiss. Anst.* **27** : 47–169.
- 1913a. Oligochäten von Travancore und Borneo. *Jb. hamb. wiss. Anst.* **30** : 73–92.
- 1913b. Die Oligochäten von Neu-Caledonien und den benachbarten Inselgruppen. *Nova Caledonia* **1** : 173–280.
- 1914. On two new species of *Pheretima* from Borneo. *Sarawak Mus. J.* **2** : 59–64.
- 1916. Oligochäten aus dem Naturhistorischen Reichsmuseum zu Stockholm. *Ark. Zool.* **10** (9) : 1–21.
- 1921. Neue und wenig bekannte Oligochäten aus skandinavischen Sammlungen. *Ark. Zool.* **13** (19) : 1–25.
- 1922. Oligochäten aus dem Rijks-Museum van Natuurlijke Historie zu Leiden. *Capita Zool.* **1** (3) : 1–67.
- 1924. Oligochäten von Holländisch-Neuguinea. *Nova Guinea* **14** : 18–27.
- 1927. Die Oligochätenfauna Brasiliens. *Abh. senckenb. naturforsch. Ges.* **40** : 369–374.
- 1928a. Die Oligochäten Borneos. *Ark. Zool.* **20** (3) : 1–60.
- 1928b. 1. Ordnung der Clitellata : Oligochaeta : Regenwürmer und Verwandte. *Handb. Zool., Berl.* **2** (8) : 1–118.
- 1929. *Pheretima (Archipheretima) ophiodes* n. sp., ein eigentümlich bunter Regenwurm von den Philippinen. *Mitt. zool. StInst. Hamb.* **44** : 85–90.
- 1930a. Ein schlangenhähnlicher Regenwurm aus Bergwäldern der Insel Luzon. *Philipp. J. Sci.* **41** : 273–280.
- 1930b. Die Oligochäten, Résultats scientifiques du voyage aux Indes-Orientales Néerlandaises. *Mem. Mus. r. Hist. nat. Belg.* **2** (5) : 1–25.
- 1932. Neue Oligochäten von Bali und Borneo. *Bull. Mus. r. Hist. Belg.* **8** (32) : 1–11.
- 1934a. Oligochäten von Niederländisch-Indien. *Archs neerl. zool.* **1** : 100–117.
- 1934b. Oligochaeta from Sarawak. *Q. Jl microsc. Sci.* **77** : 1–47.
- 1934c. Oligochäten von Französisch-Indochina. *Archs Zool. exp. gen.* **76** : 493–546.
- 1938. Einige interessante Pheretimen von Holländisch-Neuguinea. *Zool. Anz.* **121** : 161–181.
- Moreira, C.** 1903. Vermes oligochaetos do Brazil. *Archos Mus. nac. Rio de J.* **12** : 129–136.
- Ohfuchi, S.** 1937. On the species possessing four pairs of spermathecae in the genus *Pheretima*, together with the variability of some external and internal characters. *Res. Bull. Saito Ho-on Kai Mus.* **12** : 31–136.
- 1940. On the Oligochaeta from the East and West Carolines, South Sea Islands, I. *Palao trop. biol. Stn Stud.* **2** : 7–28.
- 1941. On the Oligochaeta from the East and West Carolines, South Sea Islands, II. *Palao trop. biol. Stn Stud.* **2** (2) : 279–306.
- 1951. On the terrestrial Oligochaeta from Sansei with descriptions of three new species. *Misc. Rep. Res. Inst. nat. Resour. Tokyo* **19–21** : 55–63.
- 1956. On a collection of the terrestrial Oligochaeta obtained from the various localities in the Riû-Kiû Islands, together with the consideration of their geographical distribution (Part I). *J. Agric. Sci. Tokyo* **3** : 131–176.
- Oishi, M.** 1930. On the reproductive process of the earthworm, *Pheretima communissima* (Goto et Hatai). Part I. *Sci. Rep. Tohoku Univ.* **5** : 509–524.
- Omodeo, P.** 1958. La réserve naturelle intégrale du Mont Nimba, I. Oligochaetes. *Mém. Inst. fr. Afr. noire* **53** : 9–109.
- Perrier, E.** 1872. Recherches pour servir à l'histoire des Lombriciens terrestres. *Nouv. Archs Mus. Hist. nat. Paris* **8** : 5–198.
- 1875. Sur les vers de terre des îles Philippines et de la Cochinchine. *C. r. hebd. Séanc. Acad. Sci. Paris (D)* **81** : 1043–1046.
- Pickford, G. E.** 1929. On an interesting earthworm from the New Hebrides. *Ann. Mag. nat. Hist.* (ser. 10) **3** : 493–498.

- Rao, A. S. 1974. IX. The vegetation and phytogeography of Assam – Burma. *Monographiae biol.* **23** : 204–246.
- Raven, P. H. & Axelrod, D. I. 1972. Plate tectonics and Australasian Palaeobiography. *Science* **176** : 1379–1386.
- Reynolds, J. W. & Cook, D. G. 1976. *Nomenclature Oligochaetologica. A catalogue of names, descriptions and type specimens of the Oligochaeta*, pp. i–x, 1–216. New Brunswick: University of New Brunswick.
- Rosa, D. 1890. Viaggio di Leonardo Fea in Birmanica e regioni vicini, XXVI. Perichaetidi. *Annali Mus. civ. Stor. nat. Giacomo Doria* **10** : 107–122.
- 1891. Die exotoschen Terricolen des k.k. naturhistorischen Hofmuseums. *Annln naturh. Mus. Wien* **6** : 379–406.
- 1894. Perichaetini nuovi o meno noti. *Atti Acad. Sci. Torino* **29** : 1–18.
- 1898a. On some new earthworms in the British Museum. *Ann. Mag. nat. Hist.* (ser. 7) **2** : 276–290.
- 1898b. Viaggio di Lamberto Loria nella Papuasias orientale, XXI. Terricoli. *Annali Mus. civ. Stor. nat. Giacomo Doria* **19** : 57–65.
- Sims, R. W. & Easton, E. G. 1972. A numerical revision of the earthworm genus *Pheretima* auct. (Megascolecidae: Oligochaeta) with the recognition of new genera and an appendix on the earthworms collected by the Royal Society North Borneo Expedition. *Biol. J. Linn. Soc.* **4** (3) : 169–268.
- Sivickis, P. B. 1930. Distribution of setae in the earthworm *Pheretima benguetensis* Beddard. *Biol. Bull. mar. biol. Lab. Woods Hole* **58** : 274–280.
- Song, M. J. & Paik, K. Y. 1970a. Earthworms from Chejoo-do Island, Korea. *Korean J. Zool.* **13** : 9–14.
- — 1970b. On a small collection of earthworms from Geo-je Isl., Korea. *Korean J. Zool.* **13** : 101–111.
- — 1971. Earthworms of Mt. Jiri, Korea. *Korean J. Zool.* **14** : 192–198.
- Spencer, W. B. 1888. The anatomy of *Megascolides australis* (the giant earthworm of Gippsland). *Trans. R. Soc. Vict.* **1** : 1–60.
- Stephenson, J. 1923. Oligochaeta *Fauna Br. India* **1923** : 1–518.
- 1930. *The Oligochaeta*, pp. 1–978. Oxford: Clarendon Press.
- 1931. Oligochaeta from Burma, Kenya and other parts of the world. *Proc. zool. Soc. Lond.* **1931** : 33–92.
- 1932. A reexamination of certain Oligochaeta from the Malay Peninsula (Skeat Expedition 1899–1900). *Ann. Mag. nat. Hist.* (ser. 10) **9** : 201–240.
- 1933. Oligochaeta from Australia, North Carolina, and other parts of the world. *Proc. zool. Soc. Lond.* **1932** : 899–941.
- Ude, H. 1893. Beiträge zur Kenntnis ausländischer Regenwürmer. *Z. wiss. Zool.* **57** : 57–75.
- 1905. Terricole Oligochäten von den Inseln der Südsee und von verschiedenen andern Gebieten der Erde. *Z. wiss. Zool.* **83** : 405–501.
- 1924. Neue *Pheretima*-Arten von Neu-Guinea. *Zool. Anz.* **61** : 80–85.
- 1925. Regenwürmer von Borneo. *Zool. Anz.* **63** : 103–109.
- 1932. Beiträge zur Kenntnis der Gattung *Pheretima* und ihrer geographischen Verbreitung. *Arch. Naturgesch.* **1** : 114–190.
- Vaillant, M. L. 1889. Lombriciniens, Hirudiniens, Bdellomophes, Térétulariens et Planariens. In *Histoire naturelle des Annelés et d'eau douce* **3** : 1–766. Paris.
- Vati, V. 1945. The enteronephric system in *Megascolex trivandranus* Steph., *M. auriculata* Aiyer, and *M. travancorensis* (var. *ghatensis* Mich., var. *proboscidea* Aiyer, and var. *typicus* Mich.), with remarks on vestigial nephridia. *Proc. natn. Inst. Sci. India* **11** : 245–255.
- Wadia, D. N. 1953. *The geology of India* (3rd edition). London: Macmillan.
- 1960. The post-glacial desiccation of central Asia; evolution of the arid zone of Asia. *Natn. Inst. Sci. India, Monogr.* **10** : 1–25.

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